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THE IRON TRADE REVIEW

VOLUME XXXIII. CLEVELAND, O. JUNE 14, 1900 CHICAGO, ILL. NUMBER 24

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AIR COMPRESSORS
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Complete Catalogue upon application.
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THE IRON TRADE REVIEW

VOLUME XXXIII. CLEVELAND, O. JUNE 14, 1900. CHICAGO, ILL. NUMBER 24

THE WEEK IN IRON CIRCLES.

THE MARKET AT LARGE.

The iron market is still making progress toward a lower level, without any indication that a point has been reached at which business can be done freely. Reductions in prices do not stimulate business; at the same time there is general concurrence in the view that the process is a healthful one and must be patiently endured until more light breaks upon the situation. There are those in the trade who find a remedy for the present halting attitude in such sharp cuts in values as would very greatly curtail output and put production and consumption in such relation that a gradual advance would follow, causing prices to adjust themselves eventually in a natural way. But all corrective expedients are weak because of the impossblity of securing any concert of action. Consumers being of the opinion that the present trouble is due in part to the hampering of various portions of the trade by artificial forces are not ready to find the cure in any organized action on prices or declarations of policy. The formal reduction in Bessemer pig iron and steel billets last week has not produced a ripple in the trade, and the feeling grows that the market must be given time to work out of its prosperity inertia. It is difficult to the locate pig iron market after the Bessemer furnacemen's action. Foundry iron is from $1 to $2 a ton lower than at this time last week, and that without any change in the amount or character of the buying. It is well known that stocks are increasing, also that a good many furnaces are preparing to blow out, but the undetermined fact is the net result. Valley and Eastern Pennsylvania furnaces that have just gone out or are soon to stop represent 12,000 to 15,000 tons weekly production. But the movement must widen to be very effective, since it is certain that mill operations will be very greatly reduced on July 1 No hurry is being made about wage conferences and the bar iron, tin plate and sheet mill scales are all expected to go into July without a settlement. In all these lines July is likely to be a month of inactivity, with more than a possibility that many mills will be shut down for part or all of August. It will take the closing of a large number of blast furnaces to prevent an accumulation of metal. All the Central Western steel companies that buy Bessemer pig iron have a good supply on hand. With the foundries the case is different, but their policy is to use every pound of pig iron and scrap on hand or due on contracts before buying more. It is a question whether any pronounced change in this policy will come before fall, possibly not until after the election, for the Presidential campaign is now plainly a factor in all calculations. In finished material lines there is now an openly competitive market on everything except structural shapes, and there consumers are insistent in their calls for reductions, though it is questionable if demand would be greatly stimulated by any ordinary concession. Plates have found a new level in the week, and at 1.45c at mill the plants rolling purchased steel are quite out of the race. Sales of bar iron have been made at 1.65c in Central and East Central territory, netting the mills less than 1.5c in some instances. The large agricultural contracts generally placed in the mid year have not come up as yet, and railroad buying is at a minimum. In the Central West there are reports of considerable vessel and construction business pending, the question being entirely one of price. Foreign markets have been affected in a marked way in the past fortnight by bearish reports concerning the iron trade in the United States. Middlesboro warrants fell $1 a ton, or from 73s. 3d. to 69s. 3d. in the last week in May. On June 8 they had fallen $1 more, or to 65s. 3d., but there has been a slight recovery since, the market standing to-day at about 68s. The ideas that obtain as to the amount of American pig iron likely to be sent abroad this year are greatly exaggerated. Our export iron must go at ballast rates in cotton carriers. The amount that can be carried thus is fixed within narrow limits. Any iron beyond this must go at regular freight rates, or, say, $3 a ton higher than the dead weight basis, which gives England and Germany a good factor of safety.

PITTSBURG.

OFFICE OF *The Iron Trade Review*,
828 PARK BUILDING, June 13.

The reduction in the price of Bessemer pig iron, decided on at New York last week and ratified on Friday at Cleveland by the Bessemer pig iron association, has as yet failed to start a buying movement. Inquiries for Bessemer for second half delivery are as scarce as they were when pig iron was selling at the advanced price, and the only sales noted were of a few small lots for immediate delivery at the new price of $20 Pittsburg. It has also been reported that a number of large producers have quite comfortable stocks of Bessemer iron on hand, but as yet none of it has been offered below the new association price and it is not at all probable that it will be sold below the prices the association may fix. The reduction made by the steel billet men has also failed to induce buyers to come into the market up to date and as inquiries are few, it is hardly probable that the buying movement will set in before the first of next month. The output of Bessemer and foundry iron will also be curtailed considerably during the next two months by the blowing out of a number of furnaces. In nearly every instance the furnaces are going out for repairs, and the furnacemen believe that it is a propitious time to make them. One Hubbard furnace of Andrews & Hitchcock, Youngstown, O., has been blown out for relining, and the Haselton furnace of the Republic Iron & Steel Co. has also gone out, while the Hannah furnace of the same company will shortly stop. The American Steel & Wire Co. has put out two furnaces in Pittsburg and one in Cleveland. The Rebecca, at Kittanning, Pa., one of the Lucy furnaces of the Carnegie Steel Co., and the Nittany furnace at Bellefonte, Pa., are also reported out. The Spearman and Sharpsville furnaces at Sharpsville, Pa., Thomas at Niles, O., and Ella at Middlesex, Pa., will according to report, shortly be blown out. The Scottdale furnace has been banked for connecting up new stoves, but will resume in about two weeks. It is said that other furnaces may be blown out by July 1, but the matter has not yet been definitely decided by their owners. The blowing out of these furnaces will greatly curtail production, and it is believed will result in a stiffening of the market on foundry and Bessemer iron. The reduction authorized by the steel-bar association has to a certain extent stimulated buying, but mostly in small lots, and some shading has again been reported. The price of common iron bars was not reduced from 1.90c valley, although it is certain that 1.65c can be done. Concessions are still being made on plates,

There are some rumors about plates being sold at 1.40c, but this is not confirmed. The ruling quotation is 1.50c, which in certain instances has been shaded to 1.45c.

PIG IRON.—The past week has seen no material changes in the pig iron market. The foundrymen, who seem to control the situation at the present time on Northern foundry, are still holding off and are making purchases in car lots only. Despite recent concessions they are evidently looking for better prices and are showing no signs of weakening. The reduction made in the price of Bessemer iron has not stimulated buying. Small lots have been sold for immediate delivery but nothing is being done for delivery the second half of the year. The action taken at New York was ratified by the Bessemer Association last week, thus establishing the price of Bessemer iron at $20 Pittsburg and $19.10 in the valley. Forge iron is not finding ready sale and is held at $17.50 to $18, Pittsburg. We make the following quotations:

Bessemer, valley furnace	$19 10
Bessemer, Pittsburg	20.00
No. 1 Foundry	$20.00 to 20 50
No. 2 Foundry	19.00 to 19.50
No. 3 Foundry	18 50 to 19.00
Gray Forge, valley furnace	18 00 to 18.25
Gray Forge, Pittsburg	17.50 to 18 00

STEEL.—Despite the nominal reduction made on steel billets by the largest producers no orders of importance were placed during the past week. While it has been agreed to fix the price of 4x4 billets at $28, it is not at all doubtful that this price could be shaded for a large order. Open-hearth steel is selling at $29 to $30 per ton. Nothing new has been done in sheet bars. We quote 4x4 billets at $27 to $28 at mill, Pittsburg, Wheeling or valley.

FERRO-MANGANESE.—For domestic 80 per cent the nominal quotation is $100, although this can probably be shaded on desirable orders.

RAILS AND TRACK MATERIALS.—While the producers of heavy rails are adhering to the agreed quotations, it is reported that concessions are being made by the light rail manufacturers. Rails, 25 pounds and less up to 50 pounds are reported to be selling at $34 to $35, although the agreed price is $37. Very little business has been done in track material. Our quotations are as follows: Rails, standard sections, over 200 tons, $35; 100 to 200 tons, $37; car lots, $38; less than car lots, $40; light rails, 25-pound and less than 50-pound, $37; all f. o. b. mill, Pittsburg; track material—spikes, 2.35c to 2.40c; track bolts, square nuts, 3.40c to 3.50c; hexagon nuts 3.50c to 3.75c; splice bars, 2.25c to 2.30c.

SPELTER.—There have been slight concessions in spelter during the past week. We quote 4.45c to 4.50c, Pittsburg, for prime western grades.

MUCK BARS.—There is very little doing in muck bars. A few small sales have been reported at $27 to $28. These quotations would be shaded for scrap muck.

SKELP.—There has been practically no market for skelp during the past two weeks. It is believed that with the resumption of the tube mills business will pick up. Grooved iron and steel skelp is quoted at 1.50c to 1.55c while sheared skelp is held at 1.55c to 1.60c.

BARS.—Owing to the large amount of shading on steel bars by the independent mills since the bar association fixed the price at 2c, it was decided to cut the price at a meeting held last week to 1.75c Pittsburg. Even with this reduction the manufacturers in the agreement are being asked to meet the concessions that are being made by the independent mills who in some instances are quoting as low as 1.60c to secure business. There has been practically no inquiry up to date from the implement manufacturers throughout the country for agricultural bars, although it has been their custom heretofore to place their business for the second half of the year on July 1. It is believed that with this reduction they may be induced to come into the market to close their contracts at the usual time. The reduction has induced small buyers to come into the market, and while manufacturers are not receiving large orders they are receiving enough business to keep their mills in operation. The price of iron bars was not changed although the valley quotation of 1.90c is being cut as low as 1.65c by independent mills. Refined iron bars are held at 1.85c to 1.90c and some brands are quoted considerably higher, according to quality.

STRUCTURAL MATERIAL.—The demand for all kinds of structural shapes continues very good. None of the mills in this district are about to shut down, despite contrary reports, for a lack of orders. In several instances enough business has been contracted for to keep the mills in full operation for several months. Prices are unchanged as follows: Beams and channels, 3 to 15 inches, 2.25c; 18 to 24 inches, 2.55c; tees, 2 30c; zees, 2.25c; angles, from 1½ to 6 inches, 2.10c to 2.25c. Universal mill plates, 1.70c to 1.80c, according to delivery and size of order.

PIPES AND TUBES.—The recent concessions made by the largest producer of pipes, tubes and casings has resulted in considerable buying in small lots. A number of the mills of the National Tube Co. which were shut down a short time ago are slowly resuming, and the indications are that business will increase within the next ten days as the inquiries that are being received are numerous. The independent mills are still scrambling for all the business in sight and, in instances, are cutting prices to get it. Discounts to consumers in carload lots, Pittsburg, are as follows:

MERCHANT PIPE.

	Black. per cent.	Galvd. per cent.
⅛, ¼, ⅜ inch	47½	31½
½ inch	58	43
¾ inch to 4-in., inclusive	65	49½
4½ inch to 12 inches inclusive	62	46½

BOILER TUBES.

	Iron per cent.	Steel. per cent.
1 to 1¼ inch	26	30
1¾ to 2¼ inch	32	35
2½ to 8 inch	52	55
2½ and 9 to 13 inches	42	45

CASING.

	S. and S. per cent.
2 inches	42
3 to 4½ and 8¼ to to 12¼ inches	56
4¾ to 7¼ inches	60

O. D. PIPE.

	Per cent.
4 to 22 inches	42
24 inches, o. d. and larger	37

THREADS AND COUPLINGS.

	Per cent.
14 to 16 inches, o. d.	35

PLATES.—Concessions on tank plates are again reported and it is said that an order has been placed in the past week at 1.40c. Quotations generally, however, are 1.50c at mill, but for a desirable order this could be shaded to 1.45c. These low prices have stimulated buying in small quantities, although no contracts of great importance were closed during the past few days. There is practically no demand for shell, flange, fire-box and special grades of steel. Shell steel following the price of tank plate is quoted at 1 60c to 1.65c and flange steel is quoted at 1.70c to 1.75c. Fire box and special grades range in price from 2.50c to 3 25c.

SHEETS.—There has been a little falling off in demand during the past week. Black sheets, No. 28 gauge, one pass through cold rolls are quoted at 3.20c, while common sheets without the cold-roll, pass are quoted at 3.15c. No. 7 gauge is held at 3.10c. Galvanized sheets are held at 70 and 7½ and 70 and 10, with the usual 15-cent freight allowance.

OLD MATERIAL.—Consumers are making very few purchases at the present time. A few stray car lots appear to be the extent of the week's business. We make the following quotations: New Bessemer melting stock, $17 to $18; old steel rails, mixed lengths, $18 to $19; short lengths, $19 to $20; old iron rails, $18 to $19; cast borings, $11 to $12, gross tons; cast scrap, $13 to $14; No. 1 wrought scrap, $16 to $17, net tons; busheling scrap, $11 to $12, net tons; old car wheels, $17 to $18.

COKE.—With the decline in prices for pig iron furnacemen are expecting and are being quoted better prices for coke for delivery the second half. Furnace companies consider that $2.50 coke for second half delivery would be in line with prices of metal, but no contracts at that quotation were placed in the past week. Furnace coke is quoted at $2.75 to $3 and foundry coke at $3 to $3.25. It is understood that there are furnace contracts in existence for delivery through the year at a price considerably above that now current.

CHICAGO.

OFFICE OF *The Iron Trade Review*, 1522 MONADNOCK BLOCK, June 12.

So far as the market is concerned the week has been without incident and there is very little news to relate. Reports received from the East of reductions in the prices of Bessemer iron and steel have had some effect on this market, in

that they have reduced the demand. It seems that with every reduction of prices buyers think there is another reduction in sight, and purchase only what will last them until it can be made. The local market is quite a little lower than a week ago on several products, notably pig iron, bars, plates and old material. Other products have made no change.

PIG IRON.—The local foundry trade has been entirely upset in the past week by the annual convention of the American Foundrymen's Association held in this city. Foundrymen and foundry supply men have vied with each other in entertaining the visiting foundrymen, and have given almost no thought to business. As a consequence the tonnage closed in the week was almost nil The demand appears to be fair, and one or two quite good sized contracts are in sight, but orders are very small and placed only when the consumer feels he can wait no longer before buying. How long this condition of affairs will last it is impossible to tell, but it is likely that it will continue until the large buyers come into the market for their season's supply; this, it is hoped, will stiffen the market, and bring in the smaller users of material. It does this, as a rule. Prices are materially lower than they were a week ago and our quotations are revised accordingly. It is hard to set exact quotations for the present market, but these fairly represent what present sales are being made at; should large buyers come into the market it is likely they could do better.

Lake Sup. Charcoal	$23 00@$24 00	Southern Coke No. 3	$19 10@ 19 60
Local Coke Fdy. No. 1	21 00@ 21 50	Southern No. 1 Soft	21 35@21 85
Local Coke Fdy. No. 2	20 50@ 21 00	Southern No. 2 Soft	20 35@ 21 35
Local Coke Fdy. No. 3	20 00@ 20 50	Southern Silveries	22 85@ 23 85
Local Scotch Fdy. No. 1	21 00@ 21 50	Jackson Co. Silveries	28 30@ 28 80
Local Scotch Fdy. No. 2	20 50@ 21 00	Ohio Strong Softeners	22 00@ 23 00
Local Scotch Fdy. No. 3	20 00@ 20 50	Alabama Car Wheel	22 50@ 23 00
Southern Coke No. 1	21 35@ 21 85	Malleable Bessemer	22 00@ 23 00
Southern Coke No. 2	20 35@ 21 35	Coke Bessemer	21 00@ 21 00

BARS.—At a meeting of bar makers held in the East last week prices were reduced to conform to the reductions of steel and Bessemer iron. Quotations are now made at 1.85c for steel and 1.75c for iron, half extras, Chicago delivery. It is reported, however, that mills outside of the combination have already reduced these figures 5 cents a hundred in several cases. Business is not large, and no important contracts were closed last week or are in sight for the immediate future. One or two of the larger implement makers have asked for prices, but apparently only to feel the market and not with any intention of making purchases immediately.

PLATES.—Sales have been small and unimportant and do not seem likely to increase immediately. The market is weak and prices are lower than a week ago. We quote tank steel from store 1.90c to 2c. Mill shipments, Chicago delivery: Tank steel, 1 60c to 1.65c; shell, 1.70c to 1.75c; flange, 1.75c to 1.80c; marine, 1.85c to 1 90c; fire box, 2.75c and up, according to brand.

RAILS AND TRACK SUPPLIES.—The local mills are doing a fair business in light rails, with good prospects for the future. Several good sized inquiries have been received for heavy rails, but the mills are not in position to give the deliveries required. The South Chicago rail mill met with an accident Saturday which caused a shut down of a couple of days, but it is running full again. Prices are somewhat lower on track supplies. Quotations follow: Rails, standard sections, $35 to $38; light sections, $37 to $42; splice bars 1.75c to 1.80c; spikes, 2 10c to 2.20c; track bolts, hexagon nuts, 2.75c to 2.80c; square nuts, 2.70c to 2.80c.

STRUCTURAL MATERIAL.—Business is as quiet as it has ever been. The demand is almost nothing and sales are correspondingly small. This is undoubtedly caused by the labor troubles, and conditions will not change materially until these are settled. No important contracts were placed in Chicago last week. Quotations follow: Beams, 15 inches and under, 2.40c; 18 inches and over, 2.50c; angles under three inches, 2 20c; over six inches, 2.50c; three inches to six inches, 2.40c; sheared plates, 1.60c to 1.70c; universal plates, 1.60c to 1.70c; tees 2.45c; zees, 2.40c; small lots from store are quoted ¼c to ⅓c higher.

SHEETS.—The demand is fair and quite good sales of both mill orders and store lots were made last week. Quotations are unchanged at 70 to 70 and 5 off for galvanized, and 3.50c to 3.60c for No. 27 black, for store shipment.

MERCHANT STEEL.—Sales last week were quite good and included one or two large contracts. The general demand was somewhat improved and dealers are encouraged. Smooth-finish tire steel is quoted 2.35c to 2.45c; smooth finish machinery steel 2.50c to 2.60c; spring steel, 3c to 3.25c; tool steel, 7c to 7.50c; special, 13.50c and upwards.

MERCHANT PIPE.—Good orders for small lots and an increased inquiry for larger business are reported for the week. The total tonnage closed was considerably better than in the week previous. Discounts by jobbers are made as follows:

	CARLOADS.		LESS CARLOADS.	
Pipe.	Black.	Galv.	Black.	Galv.
⅛ to ⅜ in.	45 7-10	29 7-10	37 9-10	19 9-10
½ in.	56 2-10	40 2-10	50 4-10	33 9-10
¾ in. to 4 in.	63 2-10	47 7-10	57 9-10	40 9-10
4½ in. to 12 in.	60 2-10	44 7-10	54 9-10	36 9-10
Casing.	S. and S.	I. J.	S. and S.	I. J.
2 in. to 2¾ in.	40 2-10	34 2-10	35 9-10	29 6-10
3 in. to 4½ in.	54 2-10	49 2-10	50 4-10	45 4-10
4¾ in. to 7½ in.	55 2-10	54 2-10	54 9-10	50 4-10
7⅝ in. to 12½ in.	54 2-10	49 2-10	50 4-10	45 4-10

	CARLOADS.	TUBES OUT OF STORE.	
Tubes.		Steel.	Iron.
1¾ in. to 2¼ in.		35	20
2½ in.		33	30
2¾ in. to 8 in.		47½	42½

Prices on carload lots of steel and iron tubes will be furnished on application. All f. o. b. Chicago.

WIRE AND WIRE NAILS.—Business last week was considerably in excess of that of the week previous, and gives every indication of increasing from now on. Undoubtedly the new terms offered by the makers, including a guarantee of price on unshipped orders, has considerable to do with the larger sales to jobbers. Makers quote single car loads of wire nails at $2.48 f. o. b. Chicago, and $2.63 for less than carloads. On wire, current quotations are as follows: Plain annealed wire, $2.43; painted barb wire, $2.78; galvanized barb wire, $3.08.

OLD MATERIAL.—There is almost no demand and sales are about as small as they well can be. The market is very dull and weak. Selling prices are about as made below but quite likely will be lower within the week.

Old iron rails	$17 00@$18 00	Country malleable	$11 00@$12 50
Old steel rails, long	15 00@ 16 00	Iron axles	18 00@ 19 00
Old steel rails, mixed	12 50@ 13 00	Cast borings	4 50@ 4 00
Relaying rails	26 00@ 28 00	Wrought turnings	9 00@ 10 00
Old wheels	19 00@ 20 00	Iron axle turnings	10 00@ 11 00
Railroad forge	14 00@ 15 00	Steel axle turnings	8 00@ 9 00
Dealer's forge	12 00@ 13 00	Mixed country steel	8 00@ 9 00
No. 1 cut mill	10 50@ 11 50	Stove plates	7 00@ 7 50
Heavy cast	10 00@ 11 00	Heavy melting steel	12 00@ 13 00
Railway malleable	13 00@ 14 00	Old iron splice bars	14 00@ 15 00

CLEVELAND.

OFFICE OF *The Iron Trade Review*,
CAXTON BUILDING, June 13

The ore market is still devoid of interest, apart from that which attaches to the statistics of the movement from upper lake ports. Official figures from the managers of all the shipping docks show that up to June 1 there had been shipped 3,265,888 tons, against 2,125,061 tons to the corresponding date in 1899—a gain of 1,140,827 tons, or 53 per cent. Though the season opened earlier this year than last, it is estimated that fully 3,000,000 tons was brought down last month, which is up to the best month's total of last year, a remarkable record when it is considered that frozen ore in the stockpiles delayed vessels at Lake Superior ports early last month. Such a rate of shipments, with a portion of the ore fleet scarcely more than half employed for several weeks, is an impressive comment on the capacity of the vessels now available for ore, and gives no great support to expectations of higher wild rates in the middle of the season. The blowing out of a number of valley furnaces will mean a considerable curtailment of ore consumption in the summer months, and on the Mesabi range there is evidence that the feeling as to the results of this year's business is not so buoyant. In the past week several additional vessels of the Bessemer fleet have been tied up to await a $1 25 ore rate. It is estimated that nearly 30 boats of the whaleback and Bessemer fleets are now idle. At Duluth 16 whaleback crews have been paid off.

PIG IRON.—A meeting of the Bessemer furnacemen was held in Cleveland last Friday and the action of the executive committee in fixing a price of $19 10, valley, on Bessemer iron for delivery in June and later was formally ratified. The price was made effective at once, in view of the holding up of deliveries to one consumer from all but one of the furnaces that was supplying it with Bessemer iron. The plans for relining at several valley furnaces are not definitely made in all cases, but the list of stacks expecting to go out includes Thomas at Niles, Hannah and Haselton, in turn, Spearman, Sharpsville and Ella, while one Hubbard furnace is now out.

Anna at Struthers has been about ready for relining, but has been doing better work lately and may remain in longer than was planned. There appears no foundation for the stories that a contract for 300,000 tons of Bessemer at $24 was tendered valley furnacemen for the purpose of holding up prices on certain finished material contracts based on the price of Bessemer. No business is reported as yet at $19 10 at valley furnace. Foundry iron shows the same care of the buyer to take on only enough metal to prevent a shut down. There is an impression that July 1 is a date of some significance apart from the fact that it is a time of inventory with some concerns. The shutting down of mills at that time will naturally affect the market for forge iron and for mill scrap, but in foundry iron it is likely to be a buying time if contracts for castings are made as has been customary in the middle of the year. It is hard to say on what basis a 500-ton or 1,000-ton order for foundry pig would be booked, but $18.50 at valley furnace for No. 2 would undoubtedly be shaded in view of the action on Bessemer iron. The difficulty is that buyers find trouble in believing that the bottom has been reached. Indications point to a continuance of the policy of small buying, possibly until after election. We quote the Cleveland market as follows:

Bessemer	$20 00	Valley Scotch No. 1	$20 00@20 50
No. 1 Strong Foundry	20 00@20 50	Valley Scotch No. 2	19 00@19 50
No. 2 Strong Foundry	19 00@19 50	Gray Forge, valley	18 00@18 25
No. 3 Foundry	18 25@18 50	Lake Superior Charcoal	23 00@23 50

FINISHED MATERIAL.—A number of vessels of Welland canal dimensions are likely to be placed with lake shipyards, but the business is still in suspense, with the considerable tonnage of plates and shapes that hangs upon it. We quote tank plates at 1.50c Pittsburg mill, though on a good order certain mills will quote $1 a ton lower. Some structural material orders are all but placed for work that would go ahead if the investors could be certain that shapes will not be reduced. In the absence of definite knowledge it is assumed that this line will follow others; and the fact that advances here were very conservative while other materials, particularly plates, went up rapidly, does not satisfy intending buyers that the present level should be maintained. Local business is being placed with every week, at 2.25c Pittsburg for beams and channels. Angles are hard to locate, small sizes being quoted from 1.75c to 2c at valley or Pittsburg mill and larger sizes at 2.10c. The sheet market is inactive. The shutting off of building has had its effect on the demand for roofing gauges, and stove and range requirements are light pending the disposal of stocks already made up. Neither the leading selling interest nor buyers are disposed to do anything beyond the immediate future. We quote 3.15c delivered for No. 27 black sheets. The reductions in merchant pipe have stimulated demand and some of the mills are running quite full. In bar iron the trade is a good deal at sea. Eastern mills have been quoting low prices, and while the lowest sellers are not able to furnish a full assortment of sizes, their quotations have brought down prices on the whole list. Deliveries in Central territory and Western Pennsylvania are made at 1.70c, but the inquiry has not been large enough to cause a formal reduction in the price of the leading Western producer as yet. Cut prices are being met in some instances, however, as is the case with steel bars, on which the larger mills are nominally maintaining 1.75c at mill. The market is an open one, however, and competition is being met. We quote 1.70c at mill. Valley rolling mills will close down July 1 for an indefinite time. The probabilities are that the shut down will last through July at least.

OLD MATERIAL.—In the present condition of the bar iron trade, with so many mills making short time, there is no market for scrap, and where transactions occur they are the result of heavy concessions by sellers. We quote the Cleveland market as follows: Old iron rails, $20 gross ton; old steel rails, $16.50 to $17.50 gross ton; old car wheels, $20 gross ton; No. 1 railroad wrought scrap, $15 net ton; mill scrap, $10 net ton; No. 1 machinery cast scrap, $13 net ton; wrought turnings, $9 net ton; cast borings, $7 net ton; stove plate, $9 net ton; malleable iron, $14.

WIRE AND WIRE NAILS.—Though not what either manufacturers or jobbers would have it, business in nails and wire seems to have been helped by the new terms, by which carload lots to retailers are reduced 5 cents a keg, and painted barb wire is reduced 15 cents per 100 pounds, giving a 30-cent differential between painted and galvanized. The trade has received with satisfaction the announcement of 60-day terms with 2 per cent for 10-day payment, instead of 30 days and 1 per cent, and the guarantee of the American Steel & Wire Co. against its own decline on any unshipped portions of contracts. We quote in carload lots to retailers, f. o. b. Pittsburg mill: Wire nails, $2.30; plain annealed wire, $2.25; painted barb wire, $2.60; galvanized, $2.90.

BIRMINGHAM.

June 11.

The local iron market still hesitates. There is no demand for iron and no sales of any considerable tonnage are noted. The day following the reduction in prices at Pittsburg a rumor was started here that a similar reduction had been made by Birmingham iron masters and that No. 1 foundry had been sold that day at $16, delivery to be made early in the fall. The furnace companies report that no sales were made last week at any price and that quotations were the same for several weeks past. W. H. Hassinger, district manager of the Republic Iron & Steel Co., stated that he had that day quoted No. 1 foundry at $18.50, but that no sale was made. Col. T. G. Bush, president of the Alabama Consolidated Coal & Iron Co., reports prices practically the same for several weeks, adding that there is no demand for iron and consequently there can be no fixed price. Consumers either have stocks to last them until some time in July or they pursue the hand-to-mouth policy. They will not buy in large quantities for fear the market will drop on them and thus cause them to lose on their contracts. The best grades of iron are sold up to August or September and the manufacturers are not inclined to push the market by seeking business at lower prices. If, however, an offer to take any considerable quantity of iron at $1 per ton lower than the quotations were made there is hardly a doubt that it would be accepted. The following quotations are as near correct as it is possible to make them under existing conditions:

No. 1 Foundry	$17.50	No. 1 Soft	$17.50
No. 2 Foundry	16.50 to $17.00	No. 2 Soft	16.50 to $17.00
No. 3 Foundry	15.50	Gray Forge	14.50
No. 4 Foundry	14.50		

Inquiries from Europe are more frequent of late and the inactive condition of the domestic market has had a tendency to cause the iron masters to look to the markets of the Continent as a means of possible relief. Vice-President and Treasurer James Bowron, of the Tennessee Coal, Iron & Railroad Co., leaves to-day for Europe in the interest of his company, and it is given out that he goes to look after several large orders that are soon to be placed.

The demand for the finished product continues good and the local mills are not suffering. Recently several small export shipments of bar iron have been made and it is stated that considerable attention will be paid to this class of business in the future. Local quotations on the finished product are as follows: Bar iron, 1.85c base; bar steel, 2c base; T-rails, 1 70c base; plates, ¼ and heavier, 2c; 3-16, 2.15c; No. 8, 2.10c; No. 10, 2.20c; No. 12, 2.30c; No. 16, 2.40c; No. 20, 2.60c.

The Little Belle Furnace of the Tennessee Coal, Iron & Railroad Co. at Bessemer, which was put on spiegel three weeks ago, has exhausted the supply of manganese ore and is again making pig iron. The Tennessee company is entirely satisfied with the result of the test and will accumulate another supply of manganese ore for a further run.

It is stated that the Tennessee Coal, Iron & Railroad Co. will build a steel rail mill at Ensley at once, and that the company has contracted to deliver rails beginning the latter part of 1901. The original plan of the company when the steel plant was built included a steel rail mill.

Chicago advices say: The Joliet billet mills of the Illinois Steel Co., together with the converters, started up full time on Monday morning on accumulated orders. It is expected the rod mills will also be started within a short time, if not this week. No new business has been taken by the company, but specifications on old contracts are coming in more freely. Prices are nominal.

THE River Coal Co., the fuel end of the Union Steel Co., Pittsburg, has purchased 5,000 acres of coal land on the Monongahela river, above Elizabeth.

THE IRON TRADE REVIEW
AND
INDUSTRIAL WORLD.

DEVOTED TO MACHINERY, METAL-WORKING AND FOUNDRY TRADES AND IRON AND STEEL MANUFACTURE.

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ENTERED AT THE POST OFFICE AT CLEVELAND, O., AS SECOND CLASS MATTER

JUNE 14, 1900.

ECHOES OF THE FOUNDRYMEN'S CONVENTION.

The decision of Secretary Penton, expressed some months ago, to retire from the position he has held for four years, or since the organization of the American Foundrymen's Association, was heard with much regret. That he has been the builder of the association and by his wide acquaintance, his enthusiasm and his unceasing activity has been very largely instrumental in bringing it to the strong position it holds today is recognized by every one who has had opportunity to know how the work has gone on. Four years ago the organization was formed in the belief that a field existed, outside of well known technical associations, for the development of a spirit of progress in the foundry trade and for the advancement of foundry work to a more creditable position among mechanical pursuits. There have been many skeptics to convert and many indifferent and self-satisfied foundrymen to stir into interest. This work Mr. Penton has done as probably no other man could have done, and the foundrymen of the country have him to thank for an achievement that has been waiting for years for the right man. The important work of the National Founders' Association, that really owes its existence to the American Foundrymen's Association, is making increasing demands upon Mr. Penton's energies, and after a year of service for the A. F. A. beyond the time he had fixed for retirement, his request for the naming of his successor was complied with by the Chicago convention. The choice of Dr. Moldenke is an admirable one. The Doctor has so thoroughly established his reputation as a foundry expert, both in home and foreign technical circles, that his influence in further directing the experimental work the association has undertaken will be invaluable. In spite of the pressure of work that has been upon foundrymen in the past year, the membership of the association has grown, and it is fortunate that Mr. Penton as one of the association's vice-presidents will take an active interest in its extension in the coming year.

One of the most useful souvenirs of the convention was the letter opener given away by J. D. Smith, of the J. D. Smith Foundry Supply Co., of Cincinnati, who kept "open house" in his room at the Great Northern and entertained most of the delegates at one time or another.

The room of the S. Obermayer Co., the well-known foundry supply and equipment house of Cincinnati, was open day and night, and was well furnished with drinkables and smokables, served by "Plumbago," a small boy of ebon hue. Sam. T. Johnston, J. E. Evans, Walter Adams and the rest of the "Obermayer crowd" were in evidence and greeted the guests with a warm welcome.

The souvenirs presented to the guests at the Thursday night smoker were paper weights in the shape of miniature Fedora hats of cast iron, handsomely enameled. They were manufactured by the James A. Brady Foundry Co., of Chicago.

The names of the following were registered on Thursday, and are in addition to the list printed elsewhere: J. L. Hammer, Brown Bros. Mfg. Co., Chicago; Dudley A. Johnson, Jos. Dixon Crucible Co., Chicago; J. G. Wells and C. G. Wells, Jones Plow Co., Jackson, Tenn.; Robert Johnson, Johnson & Jennings, Chicago; Wm. Barth, L. K. Hirsch, Chicago; Judson Brenner and E. F. Shellaberger, DeKalb Fence Co., DeKalb, Ill.; J. Willis Gardner, Gardner Governor Co., Quincy, Ill.; Arthur Brittan, Brittan-Mathes Co., Pittsburg, Pa.; A. B. Gardner, Estate of P. D. Beckwith, Dowagiac, Mich.; M. A. Love, Love Mfg. Co., Rockford, Ill.; D. Milton Jones, Gardner Campbell Co., Milwaukee, Wis.; M. Payton, Madison, Wis.; Cuyler D. Rees, J. I. Case Threshing Machine Co., Racine, Wis; A. M. Barron, Elkhart Foundry & Machine Co., Elkhart, Ind.; F. E. Lonas, Maywood Foundry & Machine Co., Maywood, Ill.; Donald Fraser, Chain Belt Co. and N. W. Malleable Iron Co., Milwaukee, Wis.; Geo. W. Parker, J. A. Parker, Terre Haute, Ind.

Personal.

C. A. Painter, one of the directors of the American Stee Hoop Co., Pittsburg, who recently retired as first vice-president of the company, has become one of the active partners of Henry Sproul & Co., brokers, Pittsburg.

General Manager William E Taylor, of the American Steel Hoop Co., resigned his position last week, though he will still retain his membership on the board of directors.

Henry C. Daft, for the past 15 years one of the most valued employees of the Carnegie Steel Co., died Saturday, June 9, at Ely, Minn. Ten days before his death he left Pittsburg, accompanied by his wife, for a pleasure trip to St. Paul. Upon the arrival of the train at Ely, Saturday morning, Mr. Daft was taken ill very suddenly and passed away within a few hours. The notice of his death came as a shock to his Pittsburg friends. The deceased was held in high respect by his business associates and was an accountant of more than ordinary ability. Three years ago, after 12 years of service with the Carnegie Steel Co., he was made assistant treasurer and secretary of the Oliver Iron Mining Co., its mining branch of the Carnegie Steel Co. He was also treasurer of the Pittsburg Steamship Co. Mr. Daft was 31 years old.

Mrs. Margaret Crosby Burdette, niece of the late Horace Crosby, was united in marriage to Mr. William Baker Schiller, of the National Tube Co., at Allegheny last week.

Fluctuations of the Week and the Year.

The table below shows the changes in the iron and steel stocks in the week ending June 11, also the high and low points for the year, as reported by Denison, Prior & Co.:

Name.	WEEK.				YEAR.			
	Open	High	Low	Close	High.		Low.	
Am. Car & Fdy.....	16½	16¾	16	16	18	Feb. 17	12⅜	Jan. 15
Am. Car & Fdy pr	65¾	66	63¾	63¾	67⅜	Apr. 2	59	Jan. 29
Am. Steel & Wire..	35⅜	35½	33½	34	59⅜	Apr. 2	33	May 25
AmSteel & Wire pr	70½	70½	73½	74	95	Feb. 1	73	May 21
Am. Steel Hoop.....	21½	21⅝	20⅝	21	50⅛	Feb. 6	20	May 15
Am. Steel Hoop pr	72¾	72¾	69	70	86	Feb. 6	69	May 15
Am. Tin Plate.....	22⅛	23	21⅝	21⅝	36⅛	Feb. 7	21	May 15
Am. Tin Plate pr..	73⅜	73⅜	72¾	73	84½	Apr. 9	74½	May 29
Col. Fuel & Iron...	36	36	32	32¾	51⅛	Apr. 2	32	June 9
Federal Steel.....	35½	35½	33	33	57⅜	Feb. 6	33	May 24
Federal Steel pr....	67⅜	67¾	66¼	66¼	77⅜	Feb. 6	64½	May 15
National Steel.....	30	30	28	28	53¾	Feb. 6	27¾	May 15
National Steel pr..	86⅝	87⅛	86⅛	87	97	Feb. 6	85	May 14
Pressed Steel Car..	47	47½	45½	45½	58¾	Jan. 17	42¾	May 16
PressedSteelCar pr	77½	77⅞	75½	75⅝	88½	Jan. 17	75⅛	June 8
Republic Steel.....	13⅜	13⅜	12¾	12½	27½	Feb. 6	12	May 28
Republic Steel pr..	57	58⅛	56½	56⅝	70¾	Feb. 6	52	May 2
Tenn. Coal & Iron	74	74	69	67½	104	Feb. 2	67⅛	June 9

Cyrus Balsinger, superintendent of the machinists in the armor plate department of the Homestead steel works of the Carnegie Steel Co., has been made master mechanic of the Carrie blast furnaces. William Lewis has been appointed to fill the vacancy in the armor plate mill.

THE Humbert plant of the American Tin Plate Co., Connellsville, Pa., was damaged to the extent of $7,000 by fire this week.

THE Sharon Steel Co., Sharon, Pa., has awarded the contract for 21 pumps and five condensers to Henry R. Worthington, New York.

THE IRON FOUNDRY AT THE CRAMP WORKS.

One of the largest foundries in the country engaged solely in the furnishing of castings for an individual concern is that operated by the Wm. Cramp & Sons Ship & Engine Building Co., at its works in Philadelphia. When it is remembered that the company builds battle ships of the largest and heaviest type afloat and equips them entirely within its works, some idea can be formed of the magnitude of the plant to which the foundry is related. For some time this foundry has been operated to its fullest capacity, and every available inch of its great floor area is constantly in service. The foundry was acquired by the Cramp company in 1892, by purchase from the I. P. Morris Co., which had operated it since 1845, having established itself in the foundry business about 1829. It is at present under the able management of D. J. Matlack, who served his apprenticeship with the I. P. Morris Co., and whose connection with the plant covers over half a century.

The floor area of the foundry is 37,920 square feet, with an upper gallery used for the storage of flasks and other auxiliaries, comprising an additional area of nearly 9,000 square feet. The plant is contained within a main building of brick, 288 feet long and 60 feet wide, and two wings, one 120 x 100 feet, the other 30 x 288 feet. The main building shown in Fig. 1 is utilized almost entirely for heavy work, and at times presents the appearance of a building operation. Two 50-ton electric traveling cranes, each having a hoist of 42 feet, are installed in the main building, and there are also in this building and in the wings two electric jib cranes, 15 tons

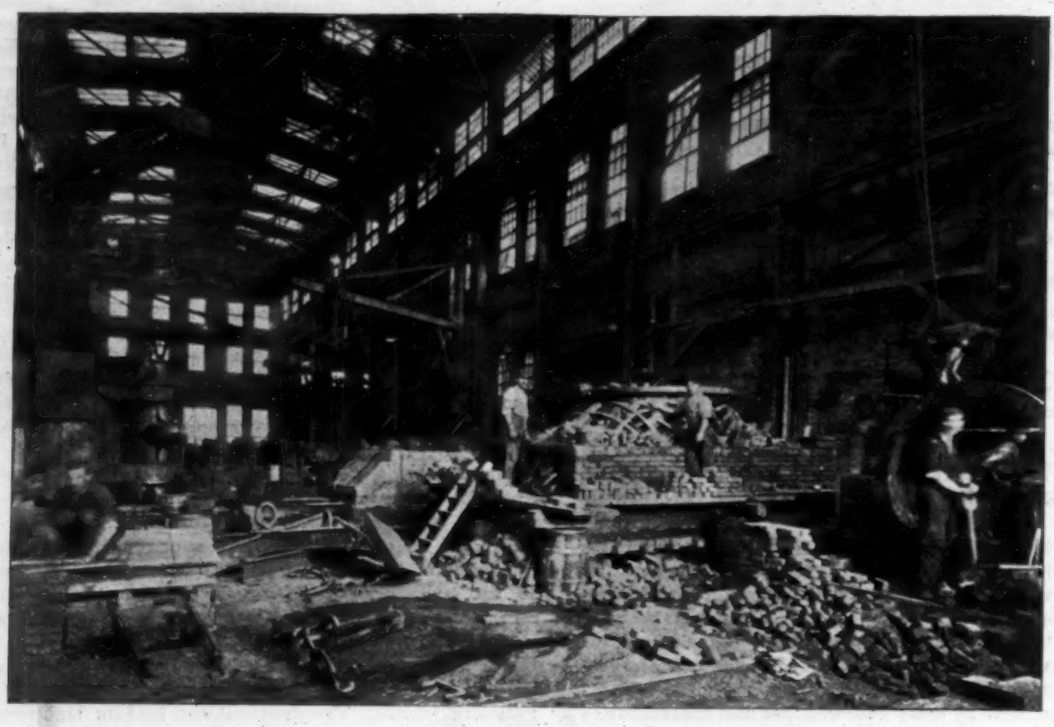


FIG. 1.—VIEW OF MAIN FOUNDRY, WM. CRAMP & SONS SHIP AND ENGINE BUILDING CO., PHILADELPHIA.

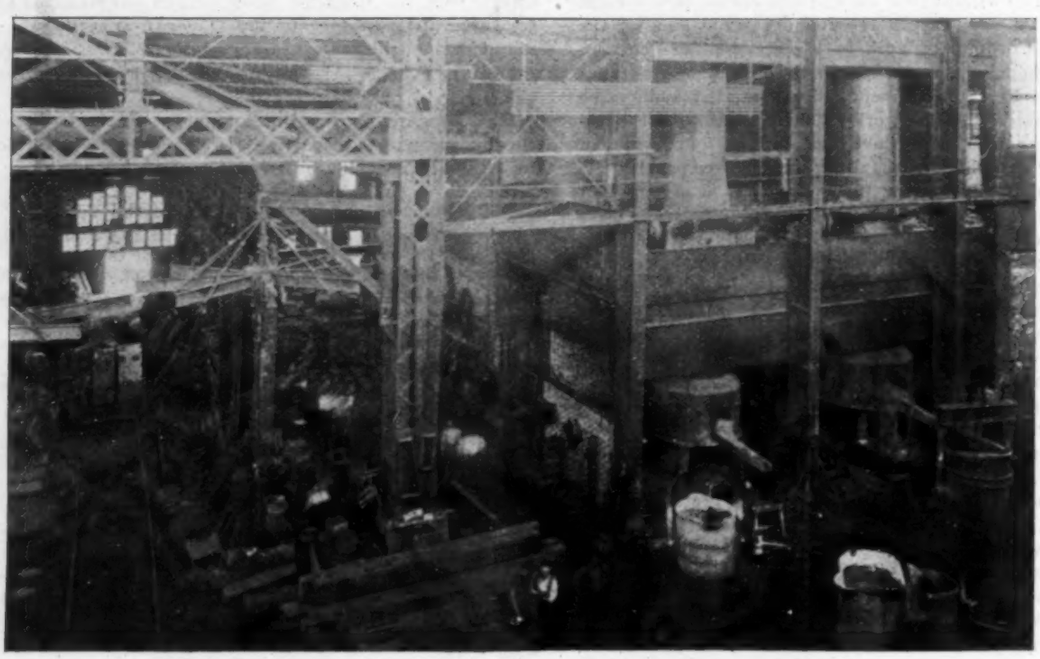


FIG. 2.—CUPOLAS AND CHARGING FLOOR.

capacity each, two hydraulic jib cranes each of 10 tons capacity, and two small 6-ton traveling cranes. In addition are several post cranes used to support pneumatic rammers and for other purposes. The end of the main building shown in the foreground of Fig. 1 is used chiefly for the construction of the larger molds. These when completed are lifted on a truck to the tracks seen, and run into two immense drying ovens near the entrance, a glimpse of the ovens being obtainable in Fig. 3. After drying, the molds are placed in pits located conveniently for pouring.

Fig. 2 shows the cupolas, with charging floor. These are located at a central point in the main building. There are three cupolas, all of the Colliau type, and 68-in., 58 in., and 32 in. capacities respectively. To the left of the cupolas is one of the wings, containing, to the right of the line of center posts, the bench molding department, and to the left and at the end the cleaning and finishing department. In the bench molding department no molding machines are used. In the cleaning and finishing department pneumatic clipping and other air tools are freely used. A compressed air plant supplies all the departments of the immense works with air power. The compressors are located about 1,000 feet from the foundry, but no trouble is experienced on this account. The pneumatic tools in general use throughout the works are of the style made by the Chicago Pneumatic Tool Co. At the rear left corner of the wing is the core-making department, and near it, along the outer wall are located five core ovens of large capacities. The floor of the long wing is used very largely for molding flat castings such as gratings and base plates. In this wing is a gallery or upper floor for the storage of flasks; and along the side on the ground floor are the foundry offices, the offices of the Government inspectors, the sand sifting room in which is located a Sellers centrifugal sifter, and a pattern storage room, all opening directly onto the molding floors.

Fig. 3 shows a pit mold in the operation of ramming. Two pneumatic rammers are seen, suspended from cranes These have been used for the ramming up to a point near the wall of the mold, but hand ramming is resorted to for finishing at the walls, and the laborers seen in the illustration are engaged in this work. The advantage gained by the use of pneumatic rammers is appreciated in this foundry, where floor space is always in demand. By the aid of the pneumatic rammer (which, by the way, is the invention of Joseph Cramp and George D. Matlack and was first used in this foundry), a large amount of time is saved in the ramming up of molds, and the floor space is in consequence more frequently available for use The mold seen was built for the casting of a large T pipe, the inlet in which was about 8 feet in diameter. The same mold is seen in Fig. 4, completed and ready for pouring.

A meeting of the directors of the recently organized J. C. Bartlett Stove Co., Pittsburg, was held last week. Officers were elected as follows: J. C. Bartlett, president; E. Hoeveller, vice president; L. A. Anshutz, secretary and treasurer. The above-named officials together with Herman Straub, August Hartje and George N. Riley form the board of directors.

It has been denied officially by the Park Steel Co. that its Pittsburg works will be removed to West Elizabeth, where ground has been broken for a new crucible steel plant. The plant will include four 50-ton open-hearth furnaces, a puddling mill and two 24-pot crucible furnaces. The power will be furnished by six water tube boilers of 250 horse-power each. All the buildings will be equipped with Morgan electric cranes.

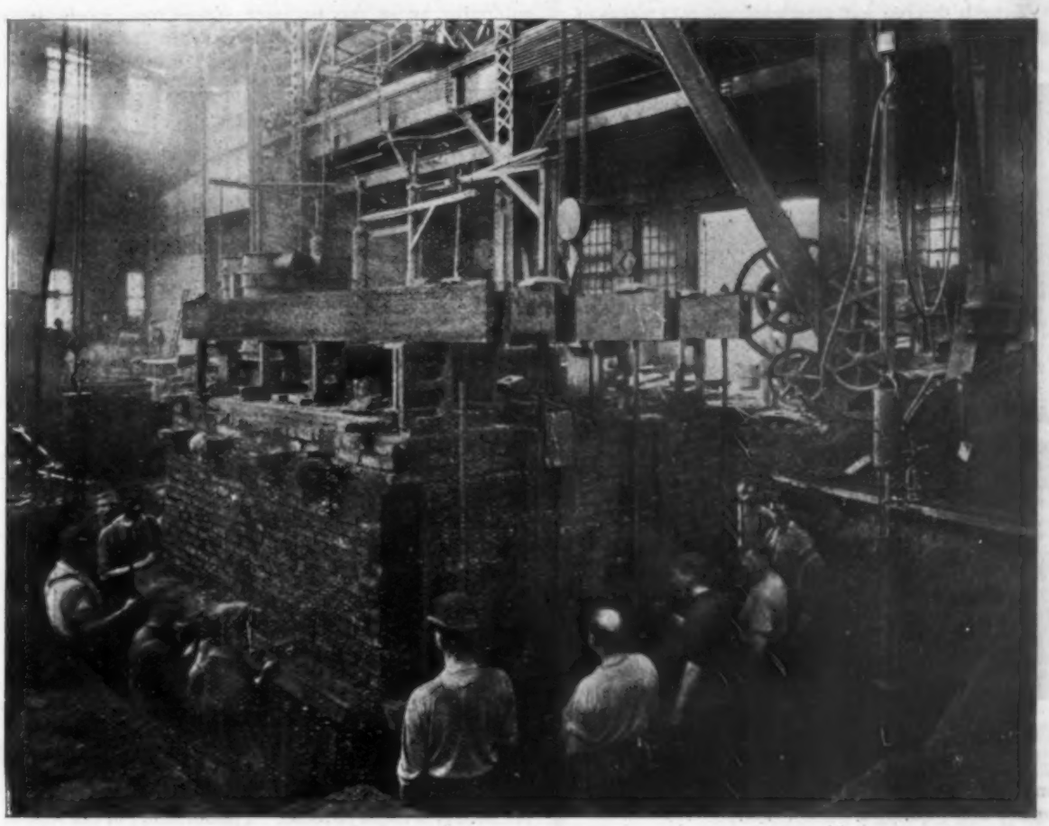


FIG. 3.—PIT MOLD, HAND AND MACHINE RAMMING.

Suit was commenced in the United States circuit court at Pittsburg last week by R. Neuman & Co., against the Leechburg Steel & Tin Plate Co. for $5,000 damages. The plaintiff alleges that the defendant company agreed to sell them 60 tons of bright cold rolled steel at $2.40 per 100 pounds, but that they only delivered 18,234 pounds that came up to specifications and 26,459 pounds that did not come up to the requirements.

The recently organized Commercial Coal & Coke Co., Pittsburg, has plans for the erection of 500 coke ovens on its newly acquired coal land along the Monongahela river. The largest portion of the product will be sent to Mexico to be used in copper smelting.

EXHIBITS AT THE FOUNDRYMEN'S CONVENTION.

A number of foundry supply firms had exhibits of their products at the American Foundrymen's Association convention at Chicago last week. Mention is made below of the more noteworthy:

The Tabor Mfg. Co., of Elizabeth, N. J., had on exhibition one of its vibrator machines, dispensing with stripping plates. The vibrator frame machine uses gated patterns without change, either with or without power ramming. With the machine were shown 13 castings from among 250 patterns on vibrator frames, cast at the Lowell Machine Shop, Lowell, Mass. The improved Tabor machine, with its adaptation to a broader range of work, has been gaining steadily in popularity among foundrymen whose demands upon molding machines are more exacting than were met by earlier machines.

Brown Bros. Mfg Co., of Clinton St., and Jackson Boulevard, Chicago, showed the Hammer core making machine, and it was operated by the inventor, J. L Hammer. The sand is thrown into an upright funnel, at the bottom of which is a worm which by the turning of a crank carries the sand into a small cylinder. The core is formed around a small rod at the end of the worm, which as the core is fed out forms the vent, perfectly true from end to end. The core can be made of any length desired and afterward cut into pieces of lengths required by the work. For the making of stock cores of diameters up to 1½ inch the machine is well adapted, working rapidly and yielding a perfect product.

The Carborundum Co., of Niagara Falls, N. Y., represented in Chicago by E. J. Eames, made a very creditable and instructive showing of its products. Interesting to those uninstructed in the production of carborundum in the electric furnace were the boxes containing the constituents of carborundum—powdered coke, silica sand, rock salt and sawdust. The large, handsome masses of carborundum crystals resulting from the union of these elements were also shown, and as a souvenir the visitors were given a piece of the crystallized product mounted on a pin. The commercial carborundum was shown in a variety of shapes for abrasive purposes—pump blocks, pot balls, rub stones and other specialties. A pyramid of carborundum wheels from 36 inches diameter to a mere point was a feature of the exhibit. A popular souvenir was a carborundum knife sharpener in a leather case. A circular found at this exhibit gave a pictorial representation of the exit of emery and the entrance of carborundum. It bore the legend: "Emery wheels were used because emery is a hard substance. Carborundum wheels are used because carborundum is a harder and sharper substance."

The Garden City Sand Co. had a representation of its various lines—fire brick, cupola blocks, molding sands and foundry facings, the exhibit being in large part special shapes in fire brick and cupola linings. The headquarters of the company are at 1201-03 Security Bldg., Chicago.

From the S. Obermayer Co.'s extensive lines of foundry supplies there were shown ladles, shovels, riddles, refractories and a general line of minor supplies.

The Sterling Emery Wheel Co., having works at Tiffin, O., and Chicago offices at 47-49 S. Canal St., in charge of Geo. W. Walker, showed a line of its emery and corundum wheels and grinding machinery. The souvenirs presented the visitors were knife sharpeners and leather-bound vest-pocket memorandums.

A Lerchen & Sons Rope Co., of 920 and 922 N. Main St., St. Louis, and 47 and 49 S. Canal St., Chicago, covered a table with samples of its wire ropes, particularly its patent flattened strand wire rope. The latter, instead of being made up of strands of circular cross section, is constructed of strands each of which has one or more flattened surfaces. Thus one flattened surface is exposed on the outside the full length of the rope, a number of wires in each strand taking the wear instead of one external wire nearest the periphery of the rope bearing the friction. With a number of wires outermost, as in the flattened strand rope, a comparatively smooth surface is presented even when the rope is new, and the wear being light upon the individual wire the tendency to brittleness is much reduced. The flexibility of the rope is also emphasized and its small liability to crushing action. The company's products include also manila rope, sisal rope, tackle blocks and cotton waster. The exhibit was in charge of Edwin E. Robirds, Chicago representative.

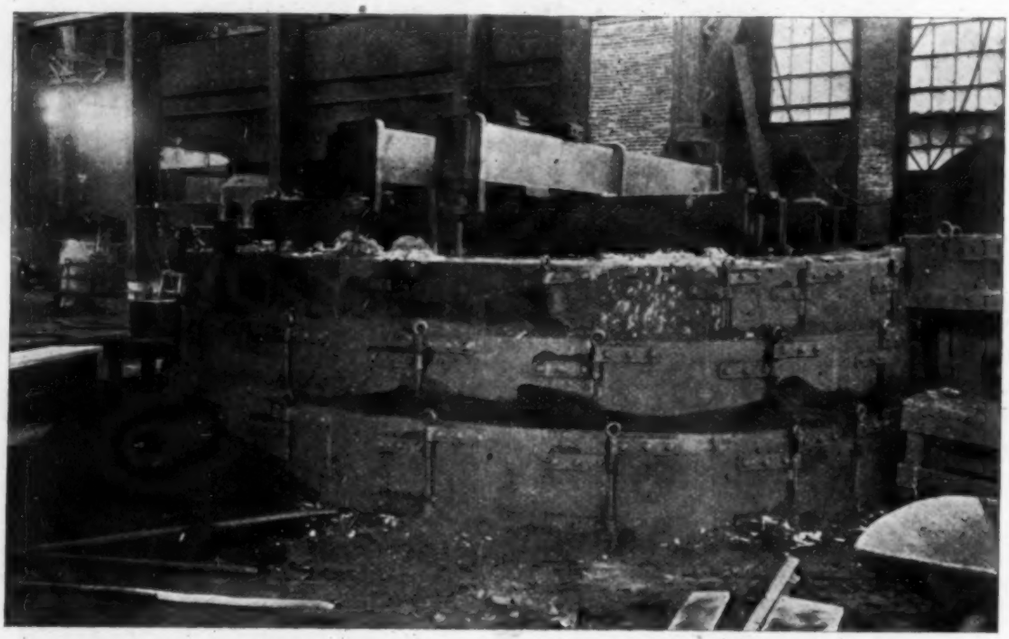


FIG. 4.—THE CRAMP FOUNDRY. T-PIPE MOLD, READY FOR POURING.

Within the next two weeks about 50 workmen employed in the rail department of the Edgar Thomson Steel works of the Carnegie Steel Co. will leave for Youngstown, where they will take positions in the new rail mill of the National Steel Co. which was put into operation about two weeks ago. The men for the most part will be employed in the finishing department.

The Monongahela Furnace of the National Tube Co., Pittsburg, was started this week after being out about two weeks.

The 10-inch mill at the Glassport, Pa., plant of the American Steel Hoop Co. was started last week after being shut down several weeks for repairs.

The charcoal department of the W. Dewees Wood Co., now a part of the American Sheet Steel Co., was closed down last week. No date has been fixed for resuming.

American Foundrymen's Association—Chicago Convention.

A SUCCESSFUL CONVENTION.

The fifth annual convention of the American Foundrymen's Association, the opening sessions of which were briefly covered in our issue of last week, was one of the most satisfactory in some particulars the association has yet held. The palm garden of the Great Northern Hotel, Chicago, proved a pleasant meeting place, albeit the sessions for papers and business were not as numerous as at previous conventions. No papers were read, except by title, on any but the opening day, Tuesday, June 5, since Wednesday was given up entirely to the excursion to South Chicago and at Thursday's business session the time was limited. At the opening session the reports of President Seaman and Secretary Penton were listened to with much interest. The enrollment of members and visitors went above 300 before the close of the convention, and while some sections were not as well represented as when the meeting was held within easier reach of their foundrymen, the gathering was quite representative. It gave indication that interest in an organization for the discussion and improvement of foundry methods and the discovery and spread of information about the nature and treatment of cast iron, is not declining, and that there is ample room for two national organizations—the one devoted to the labor problem and the other to the development of the industry on its technical side. We give below a complete roster of members and visitors:

Members and Guests.

J. S. Seaman, Seaman-Sleeth Co., Pittsburg.
S. G. Hobert, Valley Iron Works, Appleton, Wis.
H. J. Rober, Betterdorff Metal Wheel Co., Springfield, O.
Henry Hansen, *The Foundry*, Detroit.
K. C Gardner, Lloyd Booth Co., Youngstown, O.
Enrique Touceda, Albany, N. Y
Frano D. Runser, Mahoning Foundry & Machine Co., Youngstown, O.
Walter P. Warren, Jr., Fuller-Warren Co., Troy, N. Y.
Otto R. Roenius, Grand Rapids Foundry Co., Grand Rapids, Wis.
C. W. Russell, Russell Wheel & Foundry Co., Detroit, Mich.
Jas. Higgins, Detroit, Mich.
Jas. Sterling, Harlan & Hollingsworth, Wilmington, Del.
Jno. A. Penton, secretary, Detroit, Mich.
John Hill, Hill & Griffith Co., Cincinnati, O.
H. B. Davison, Lorain Foundry Co., Lorain O.
J. P. Golden, Golden Foundry & Machine Co., Columbus, Ga.
Robt. Blyth, Walker & Pratt Mfg. Co., Watertown, Mass.
O. H. Davidson, Maywood Foundry & Machine Co., Maywood, Ill.
John Magee, Magee Furnace Co., Boston, Mass.
E. W. Anthony, Smith & Anthony, Boston, Mass.
J. W. Winchester, Magee Furnace Co., Boston, Mass.
N. B. Nolan, Litchfield, Ill.
John A. Meighan, Dawson Bros. & Meighan, Pittsburg, Pa.
C. A. Stroh, Penn Casting & Machine Co., Allegheny, Pa.
C. S. Bell, C. S. Bell Co., Hillsboro, O.
S. B. Robinson, Robinson Machine Co., Monongahela, Pa.
A. A. Cordingly, Queen City Foundry Co., Denver, Colo.
F. S. Caldwell, Hill & Griffith Co., Cincinnati, O.
J. D. Smith, J. D. Smith Foundry Supply Co., Cincinnati.
J. G. Sadlier, Springfield Foundry Co., Springfield, O.
P. G. Smith, J. D Smith Foundry Supply Co., Cincinnati.
A. I. Findley, *The Iron Trade Review*, Cleveland, O.
J. R. Horner, Galion, O.
J. J. Burgen, Lane Mfg. Co., Montpelier, Vt.
F. B. Farnsworth, McLagan Foundry Co., New Haven, Conn.
Jas. Lanigan, Davis Foundry Co., Lawrence, Mass.
Peter Donnelly, Acme Harvester Co., Pekin, Ill.
Robt. S. Ogg, Hutchins & Co., New York.
Edward Niver, Niver Iron Works Co., Muscatine, Ia.
John W. Burr, Burr & Houston Co., Brooklyn, N. Y.
August H. Klotz, Klotz Machine Co., Sandusky, O.
Alex. Jarecki, Jarecki Mfg. Co., Erie, Pa.
E. H. Mumford, Tabor Mfg. Co., Elizabeth, N. J.
Wm. Yeagle, Wm. Yeagle & Co., Pittsburg, Pa.
S. D. Sleeth, Westinghouse Air Brake Co., Pittsburg, Pa.
Jno McLaren, Phillips & McLaren, Pittsburg, Pa.
Thos. D. West, Thos. D. West Foundry Co., Sharpsville, Pa.
T. E. Malone, J. S. McCormick Co., Pittsburg, Pa.
W. W. Sly, Cleveland.
Dr. R. G. G. Moldenke, Pittsburg, Pa.
J. C. Ford, Spring Lake Iron Co., Fruitport, Mich.
J. H. Gill, Raleigh, N. C.
A W. Fink, Converse, Ind.
T. B. Walsh, Frost Mfg. Co., Galesburgh, Ill.
W. Fitzpatrick, S. Obermayer Co., Pittsburg, Pa.
Geo. Wiard, Wiard Plow Co., Batavia, N. Y.
S. A. McRoberts, *American Manufacturer*, Pittsburg, Pa.
W. E. Barnes, *Age of Steel*, St. Louis, Mo.
Willis Brown, Walker-Fay Co., Erie, Pa.
F. W. Woodburn, S. L. Moore & Sons Co., Elizabeth, N. J.
H. T. Rowley, S. L. Moore & Sons Co., Elizabeth, N. J.
F. E. Gordon, Onio Sand Co., Conneaut, O.
J. W. Dopp, Lowell Machine Shop, Lowell, Mass.
T. P. Kelly, T. P. Kelly & Co., New York.
Harry Bell, Dodge Mfg. Co., Mishawaka, Ind.
F. P. Howlett, Dodge Mfg. Co., Mishawaka, Ind.
L. K. Brown, Zanesville, O.
C. S. Lovell, Tabor Molding Machine Co., Elizabeth, N. J.
S. D. Tompkins, Smooth-On Mfg. Co., Jersey City, N. J.
C. B. Reed, Parlin & Orendorff Co., Canton, Ill.
W. H. Williams, Parlin & Orendorff Co., Canton, Ill.
M. E. Kanavel, E. M. Ayers, Zanesville, O.
J. F. Dye, Newport Sand Bank Co., Newport, Ky.
A. J. Lindeman, A. J. Lindeman & Haverson Co., Milwaukee.
J. A. Kittleson, Moline Scale Co., Moline, Ill.
H. P. Deuscher, H. P. Deuscher Co., Hamilton, O.
F. H. Smith, Smith Fillet Works, Akron, O.
M. Shanahan, Grand Rapids Foundry Co., Grand Rapids, Mich.
Otto W. Schaum, Schaum & Uhlinger, Philadelphia, Pa.
J. P. Winlock, Barbour-Stockwell Co., Cambridgeport, Mass.
John F. Mills, Abendroth Bros., New York.
Wm. H Kelly, Buckeye Engine Co., Salem, O.
F. F. Keller, Grand Rapids Foundry Co., Grand Rapids, Mich.
F. A. Connor, Grand Rapids Foundry Co., Grand Rapids, Mich.
R. S. Macpherran, E. P. Allis Co., Milwaukee, Wis.
Frank Leuthner, Lackawanna Iron & Steel Co., Scranton, Pa.
M. F. Gartland, Marion Gray Iron Foundry Co., Marion, Ind.
A. Barr, United States Wind Engine & Pump Co., Batavia, Ill.
Geo. F. Crivel, F. B Stevens Co., Detroit, Mich.
Leopold Leuthner, Lackawanna Iron & Steel Co., Scranton, Pa.
T. J. Mosher, Mosher Mfg. Co., Dallas, Tex.
Geo. S. Tillotson, Sterling Emery Wheel Co., Tiffin, O.
J. B. Green, S. Green & Sons, Des Moines, Ia.
Thos. M. Roche, *The Foundry*, Detroit, Mich.
W. C. Pendleton, Trumbull Mfg. Co., Warren, O.
A. G. Buck, Carborundum Co., Niagara Falls, N. Y.
E. H. Walker, J. I. Case Threshing Machine Co., Racine, Wis.
W. A. Driver, Lakeside Malleable Iron Co., Racine, Wis.
A. W. Slocum, Keystone Car Wheel Co., Pittsburg, Pa.
A K. Beckwith, Estate P. D. Beckwith, Dowagiac, Mich.
E. J. Woodison, S. Obermayer Co., Cincinnati and Detroit.
H. E Beckwith Estate P. D. Beckwith, Dowagiac, Mich.
Nathaniel French, Davenport Metal Wheel Co., Davenport, Ia.
Benj. D. Fuller, Westinghouse Electric Mfg. Co., Pittsburg, Pa.
J. F. Pendleton, Westinghouse Electric Mfg. Co., Pittsburg Pa.
Geo. P. Nichols, Pawling & Harnischfeger, Milwaukee, Wis.
E. J. Eames, Carborundum Co., Niagara Falls, N. Y.
A. W. Bair, Chicago, Milwaukee & St. Paul Foundry, Milwaukee, Wis.
Frank M. Etting, Edw. J Etting, Philadelphia, Pa.
L. E Wood, M. J. Drummond Co., New York City.
Isaac T. Capron, Ashland Empire Mills, Perth Amboy, N. J.
J. B Jones, Utica Heater Co., Utica, N. Y.
A. E Daak, Whitehead Bros. Co, New York City.
Chas Mohlman Schenectady, N. Y.
B M. Shaw, Walker & Pratt Mfg. Co., Boston, Mass.
Frank Kelly, Kelly Foundry & Machine Co., Goshen, Ind.
M. F. Gallagher, New York Air Brake Co., Watertown, N. Y.
E. R. Rundle, Central Foundry Co., Milwaukee, Wis.
Frank C. Schroerer, Indianapolis Foundry Co., Indianapolis, Ind.
Chas. L. Bauer Louis E. Bauer, Warder, Bushnell & Glessner Co., Springfield, O.
W. G. Scott, J. I. Case Threshing Machine Co., Racine, Wis.
E. J. Eames, Jr., Carborundum Co. Niagara Falls, N. Y.
J. B. Friske, Illinois Iron & Bolt Co., Carpentersville, Ill.

F. H. Wilmott, G. A. Hackett, Sattley Mfg. Co., Decatur, Ill.
E. J. Lyon, Brown & Sharpe Mfg. Co., Providence, R. I.
Col. A. M. Shook, Tennessee Coal, Iron & Railroad Co., Birmingham, Ala.
H. S. Brackett, Hill & Griffith Co., Cincinnati, O.
F. W. Sivyer, Northwestern Malleable Iron Co., Milwaukee, Wis.
P. R. Ramp, C. B. & Q. Foundry, Aurora, Ill.
W. O. Jones, Piano Mfg. Co., West Pullman, Ill.
O. M. Stowe, Union Malleable Iron Co., Moline, Ill.
Wm. N. Gartside, Diamond Clamp & Flask Co., Richmond, Ind.
W. A. Hance, Stover Engine Works, Freeport, Ill.
Philip Carroll, Carroll Foundry, Houghton, Mich.
H. McPhee, Eaton, Cole & Bernham, Bridgeport, Conn.
T. H. Gartland, Gartland, Foundry Co., Cleveland, O.
J. G. Pope, Falls Rivet Machine Co., Cuyahoga Falls, O.
A. F. Koons, Webster, Camp & Lane Machine Co., Akron, O.
H. F. Frohman, S. Obermayer Co., Cincinnati, O.
W. H. Orcutt, McElwaine-Richards Co., Indianapolis, Ind.
J. H. Whiting, Whiting Foundry Equipment Co., Harvey, Ill.
Geo. G. Guy, United States Wind Engine & Pump Co., Batavia, Ill.
H. G. Shumway, C. W. Shumway & Son, Batavia, Ill.
J. A. Anderson and J. W. Welsh, Seiberling Plate Glass Co., Ottawa, Ill.
E. S. Gaylord, Cleveland Facing Mill Co., Cleveland.
Edward E. Squires, Fluorspar Co., St. Louis, Mo.
Arthur L. White, Lima Locomotive & Machine Works, Lima, O.
L. W. Young, Pennsylvania Malleable Co., Pittsburg, Pa.
J. P. Evans, Galesburg, Ill.
A. V. Peterson, Galesburg, Ill.
Wm. S. McNaughton, Matthew Addy & Co., Cincinnati.
W. A. Field, Simmons Mfg. Co., Kenosha, Wis.
Peter Chalmers, Racine, Wis.
Stanley G. Flagg, Jr., Stanley G. Flagg & Co., Philadelphia.
Walter J. Kohler, Sheboygan, Wis.
Arthur H. Hayssen, Sheboygan, Wis.
C. A. Stevenson, Stevenson, Field & Co., St. Louis.

CHICAGO DELEGATES AND VISITORS.

P. D. Sloan, Garden City Sand Co.
Jas. A. Brady, Jas. A. Brady Foundry Co.
B. M. Gardner, *The Iron Trade Review.*
I. L. McCord, Maywood Foundry & Machine Co.
T. J. Hogan, secretary Stove Founders' Association.
Geo. W. Cope H. H. Roberts, and W. A. Douglass, *Iron Age.*
David Evans, Sloss Iron & Steel Co.
D. F. Eagan, H. E. Pridmore.
H. L. Williams, Hickman, Williams & Co.
R. B. Hickman, Hickman, Williams & Co.
E. C. Louis, Hickman, Williams & Co.
B. R. Marchand, Illinois Steel Co.
J. F. Coykendall, Fraser & Chalmers Co.
Chas. Vickers, Sterion Copper, Brass & Bronze Co.
Malcolm McDowell.
B. T. Bacon, Pickands, Brown & Co.
J. M. Arnold, Preble Machine Works.
R. B. Jones, Preble Machine Works.
Jos. J. Olson, Rogers, Brown & Co.
H. A. Forsyth, Miller, Wagoner & Feiser Co.
W. A. Jones, W. A. Jones Foundry & Machine Co.
R. J. Cleveland, Cleveland & Barr.
R. C. Barr, Cleveland & Barr.
G. L. Hopping, Tarrant Foundry Co.
S. T. Johnston, S. Obermayer Co.
Chas. French Iron & Steel Co.
Jas. Fyfe, Pickands, Brown & Co.
Geo. W. Walker, Sterling Emery Wheel Co.
Walter C. Clark, Sterling Emery Wheel Co.
Chas. L. Miner, Matthew Addy & Co.
E. F. Axner, Matthew Addy & Co.
W. E. Wakefield, J. W. Reedy Mfg. Co.
H. E. Pridmore.
E. E. Robirds, A. Leschen & Sons Rope Co.
E. E. Tratman, *Engineering News.*
L. W. Noyes, Aermotor Co.
W. S. Seymour, Pickands, Brown & Co.
C. S. Reed, Chicago Retort & Fire Brick Co.
Frank Taylor, Hussman Crucible Co.
W. J. Adams, S. Obermayer Co.
Geo. M. Sargent, Sargent Co.
J. W. Gardner, Sargent Co.
J. T. Howell, Board-Cumming Foundry Co.
C. L. Lingo, Rogers, Brown & Co.
Chas. E. Hoyt, Lewis Institute.
H. S. Vrooman.
D. L. Cobbs, Sloss Iron & Steel Co.
V. C. Hamer.
John Brady.
Wayne Wills, Rogers, Brown & Co.
Frank I. Foote, Rogers, Brown & Co.
H. G. Lloyd, Eagle Emery & Corundum Co.
J. E. Urban, Fairbanks, Morse & Co.
John Rogers, Home Stove Works.
C. J. Wolff, L. Wolff Mfg. Co.
Fred. Wolff, L. Wolff Mfg. Co.
E. C. Greenlee, Greenlee Foundry Co.
W. L. Getchell, Hussman Crucible Co.
J. E. Evans, S. Obermayer & Co.
J. J. Kinnane *Iron and Steel.*
B. E. Greene, Pickands, Brown & Co.
M. C. Armour and E. L. Billingslea, Rogers, Brown & Co.
D. W. Buchanan, Jas. A. Brady Foundry Co.
Wm. Ferguson, Wm. Ferguson Foundry Co.
Irvin McDowell, Stevenson, Field & Co.
A. B. Stevenson, Stevenson, Field & Co.
W. W. Backman.
W. B. Easton, Fraser & Chalmers.
W. H. McCarthy, Chicago Fire Brick Co.
R. L. Greenlee, Greenlee Foundry Co.
W. B. Greenlee, Greenlee Foundry Co.
R. M. Woods, Piano Mfg. Co.
E. D. Green, Garden City Fan Co.
W. W Green, Garden City Fan Co.
J. O'Hara, Garden City Fan Co.
A. B. Holmes, Standard Pneumatic Tool Co.
M. A. Rourke, Western Foundry Co.
T. H. Cullinan, Western Foundry Co.
Wm. Francis, Francis & Nygren Foundry Co.
S. D. Palmer, Aermotor Co.
C. E. Noyes, Johnson & Noyes.
A. W. Johnson, Johnson & Noyes.
Geo. A. Davidson D. H. Preston Co.
C. H. Hopke, Chicago Hardware Mfg. Co.
H. S. Lloyd, Eagle Emery & Corundum Wheel Co.
E. E. Hanna, Gates Iron Works.
O. T. Stantial, Illinois Malleable Iron Co.
S. W. Lukens, Illinois Malleable Iron Co.
C. C. Colby, Illinois Malleable Iron Co.
G. J. Reeling, Illinois Malleable Iron Co.
F. S. Phelps, Henry E. Pridmore.
H. C. Chase, Maywood Foundry & Machine Co.
Henry Penton, Chicago Shipbuilding Co.
W. S. Eden.
L. J. Highland, Maywood Foundry & Machine Co.
R. H. Brown, Greenlee Foundry Co.
Geo. Kurtz, Kurtz Foundry Co.
Michael Brucker, Brucker Foundry Co.
D. Kauffman, L. K. Hirsch.
A. M. Thompson, Link Belt Machinery Co.
R. F. Oglesby, T. P. Kelly & Co.
F. H. Johnson
C. J. Wiltshire and H. Loudenbeck, Gates Iron Works.

The annual report of President Seaman is as follows:

President's Report.

In presenting the customary annual report in review of the association's activity during the past year, I must first congratulate you all on the magnificent outlook for the iron industry here and abroad. That we should all be so busy at home so that the question of leaving our interests for even the few days of this convention becomes a serious one, is only one of the encouraging features of an industrial revival unparalleled in the history of this country. While prices will not always remain so high as they now are, the indications are for a long continued period of prosperity based upon moderate profits.

That the abnormal activity in the foundry trade has brought about serious clashes between the vested interests and those depending on the same is deplorable enough, though unavoidable so long as human nature is constituted as we know it. The bitterness and brute violence formerly attending such disputes seems at last to have yielded to more peaceable and therefore more effective means of argument. Fortunately for our association the contentions between capital and labor are far removed from its sphere of influence, and industrial education in its truest sense is the keynote of our aim and object.

Looking over the field of foundry movements during the past year we see a notable effort made in modernizing equipment, especially in the new shops and the extensive additions to the old ones. It is not now a question of how much it costs, but how well will the outlay required pay. Consequently we can see hundreds of thousands of dollars spent this year where formerly the tenth part would have seemed excessive. This can have but one result—a preponderating tendency to specialization; foundries managed by men specially trained in the economies of manufacturing; the treatment of the labor problem along lines of the true political economy; and in fact a quiet revolution from the numerous "all-around" jobbing foundries to vast specializing industrial plants.

In this connection I commend to your attention a proposal to be brought before you later on relative to the higher training of our future foundry managers. The time when the foundry will be recognized as an integral part of the vast metallurgical field where the best talents are required and appreciated is fast approaching, and the onward march of knowledge in things relating to the smelting of other metals so thoroughly exploited, should be made to embrace the peculiar alloy of iron with carbon on which we have built up such an immense industry. May the "fittest" survive in bringing about this improvement.

While many foundries have been built during the year and numerous other ones are now greatly enlarged, the most notable advance has been made in the field of malleable and steel castings. An imposing list of these enterprises, remarkable for their financial strength, shows that these particular branches of the foundry trade have felt an unmistakable impetus of late.

What the future will bring us is hard to predict. The excessive demand caused by the actual needs of a country started out by a long period of financial depression may hold out just long enough to present a solution to the threatening aspect of great industrial combinations. Perhaps this solution will be simple enough when fierce competition once more reigns supreme; but time alone can tell.

You will receive reports from our two special committees, each showing a fair measure of progress in spite of the enormous strains the individual member has been under all this time. The standard drillings of the association as check samples are now recognized everywhere as authoritative and the work of testing the various kinds of cast iron which is progressing quietly has attracted world-wide attention in showing the enormous possibilities and adaptations our various products are fitted for in the commercial economies of national existence.

I am specially pleased to report that my suggestion regarding closer union between the local associations and the American Foundrymen's Association has been materially aided by the simultaneous reading of papers by all foundrymen interested in foundry progress, and would recommend to you a still closer relationship of the "local" with the "American" so that a member of the former becomes *ipse facto* a member of the latter and may enjoy all its rights and privileges. If you so choose to act, a committee might find in this subject profitable study during the year and report a plan for discussion and possible ratification at the coming convention in 1901. Of the internal affairs of this association I can tell you nothing that is not contained in the reports of your secretary and treasurer, and in closing my own report I can only express the heartfelt wish that success and prosperity attend each and every member of this splendid association at all times.

Secretary's Report.

Secretary Penton's annual report was an interesting study of the tendencies in the foundry trade that have either made their appearance or have become more pronounced in the past year. Concerning the membership of the association it showed a net gain of 31 in the year making the present enrollment 314. In his review of association work and of conditions in the trade the secretary says:

During the year that has passed since our association last met the foundrymen of America have been busier than at any period during the past decade, and from an industry that suffered as much if not more than any other on the continent as a result of the previous year's depression, it found itself suddenly participating in the revival that was as widespread as it was in some respects extraordinary. While this activity had all the appearances of bringing with it a proportionate amount of prosperity, yet it is well known that in proportion to the increased cost of raw material, fuel, labor, etc., the profits of the foundrymen per ton have not been in harmony with anticipations. In addition to this, and to add to the serious uncertainty of the situation at this time, we find everywhere a large falling off in the volume of business and a still more noticeable lessening of inquiries and decrease in the amount of new business offering.

As yet the agricultural and malleable interests have suffered the most, but there are not wanting signs of a lull in other lines of the foundry business that may, during the balance of this year, very visibly affect the volume of production. While it is true that iron, all things considered, has held its own very wonderfully, and that stocks on hand have not increased materially, there is no doubt that a gradual shading of prices has been inaugurated that bids fair to continue for some time to come. It is conceded by all producers, as well as consumers, that this is inevitable, the only question being the speed with which the market is likely to decline, and this will probably be determined by causes that can neither be foreseen nor controlled.

The far-seeing foundryman who realizes the unsubstantial character of anything that savors of a "boom" never fails to continue his efforts to reduce cost by a close study of every condition that affects his production, and this accounts for the fact that there has never been a period in our history when as much attention has been given to economical appliances and methods for the rapid, efficient and cheaper production of castings of every kind.

The construction of patterns and core-boxes, both large and small, especially when much duplication is possible, is now closely scrutinized and carefully studied to such an extent that the improvements being made from year to year in this department alone requires constant attention if one desires to keep abreast of the times. The many changes, some of them of course of a minor nature, that are being constantly made in follow boards, clamps, flasks and similar devices amount to a great deal in the aggregate, and it is surprising to note what ingenuity can accomplish even in these respects, and the great difference that exists between founders doing oftentimes the same kind of work.

But the greatest revolution of all has been made by the molding machine. No one would have been warranted in predicting five years ago what has been possible of accomplishment in 1900 in this respect. It is true of course that in a vague sort of way an optimistic foundryman would say that great things were likely to be consummated, but there were no exact data upon which to base any conclusion other than a general feeling that we have been drifting "machinewards." The growth of the machine in popular favor, and the universal appreciation of its adaptability to a wide range of work has been most remarkable, and every day brings new converts to the already large army of believers in its increasing utility. Patterns that it was thought a few years ago must always be molded by hand are now successively made on some of the many types of machines that are on the market, and foundrymen who, with a conservatism worthy of a better cause have been clinging tenaciously to old methods, have been compelled to see the splendid results their own competitors on similar kinds of work have been securing and are beginning to feel the pressure that the machine exerts as an economizer and competitor. Just where the line must be drawn between the possible and the impossible in this respect is hard to say, but it is not fair to assume that the thought the advent of the machine has inspired towards systematizing may permeate the manufacture of castings of a larger size, and result to the benefit of the advanced foundryman in that line also by an improvement in some method or other?

The machine has brought strongly to the front the fact that there is a factor that must be reckoned with in the management of the foundry which does not view with favor its rapid introduction, viz., labor and labor organizations. The molder and his union have placed themselves on record as not being opposed to the machine, but on the contrary are so much in favor of it that they are inclined to insist upon its control being put in their hands to the extent that none but union men should be employed to operate it. The irony of this is of course self evident, and no one, not even the union advocates of that policy, are deceived as to what it means, viz., "restricted output."

It is a very grave question whether or not the molder is so seriously handicapped by education, environment and association in the efforts to bring out the machine's best possibilities. If he is a good molder he will not care to work upon a machine whose operation in only manual labor of a severe kind. He will not be as interested in his work as in the production of a mold that requires from him a degree of artistic skill, and as a result of his having had inoculated into his system a sort of reverence for the unwritten law of the "set day's work," he lacks the interest that is taken by the laborer to

whom the operation is never other than that of laboring, who makes no unnecessary steps or needless moves, and with whom the only law that regulates or controls his output is his own efficiency. Instances are plenty where the introduction of the machine has been opposed unless a union man willed to operate it, and as this meant no advantage to the proprietors the machine is of course of no value, and that proprietor is not permitted to produce the castings he requires in the way he may select, or as cheaply perhaps as his competitor not hampered with such restrictions.

There are, as a result of this condition, several consequences which may admit of reference here. In the first place the real or fancied antagonism of the molder to the machine has only served to stimulate the activities of inventors, machine producers and foundry proprietors, and it is possible that the machine may have received in some degree an impetus from this source. In the second place, the fact that it is antagonized and the fear that it may be antagonized, may prevent temporarily its introduction or more general use, but this very antagonism must operate as a sort of stimulus which sooner or later must inevitably result in the introduction and operation of the machine, or in any other contrivance that will serve eventually as a cost-reducer. It has been so from the first, when machines of any kind were opposed, and always will be.

In the line of new foundry structures and their suitability for the particular class of work for which they are designed, their location, etc., more and more is being done every day, and the number of plants in existence that might be called model in every respect are steadily on the increase. Not only so, but the improvements that are being constantly made in such items as cranes, ladles, core ovens, annealing ovens, conveyors, etc., and their still more general adoption, are all evidence that the foundryman is thinking and studying, and that in the near future it will be a difficult matter to remain in the business successfully unless close attention is given to every detail in these respects.

Then we have those who have given up much of their valuable time to the study of iron and its use, and to whom the foundry world must always owe a debt of gratitude for their unselfish labor.

It must be conceded that relatively speaking and in proportion to the interests and number of men involved, labor troubles have not been as frequent in the foundry or iron business the past season as they have in other lines, and while it may be too early to offer any predictions, yet it is hoped, and I am sure all will join me in the desire, that such arrangements may yet be perfected between foundry employees and employers as will for all time bring about closer and more harmonious relations, and set a precedent for employers in other lines to follow.

It is pleasing to note that the interest in the American Foundrymen's Association seems to be steadily maintained, and that deducting resignations we have had up to date a net gain in membership of 31 during the past year. Your secretary regrets to say that our highly esteemed friend and treasurer, Mr. Howard Evans, has been in very poor health the past year and this will again prevent him from being with us, but he feels that when another convention rolls around he may again have the pleasure of meeting with the association that he did so much to organize and for which he has labored so earnestly.

Reports on Standards for Testing Cast Iron.

Dr. Richard Moldenke, chairman of the Association's Committee on Standardizing the Testing of Cast Iron, presented a report of progress supplementing the record of the prodigious results laid before the Pittsburg convention of 1899. The report says:

"Your committee begs to report the further progress made in its work during the interval of time between conventions. The phenomenal activity of the trade has naturally been felt very keenly by us all, so much so that it took three months of unremitting effort on the part of one member to cast the two partial sets of bars tested during the year. Another member of the committee, who is trying to give us two other sets of test bars, has vainly been endeavoring to do so for the greater part of the year. While this state of affairs is rather discouraging to the testing industry, yet it must not be forgotten that the years of prosperity are not always those of progress. The lean years give more leisure for investigation and bring with them a greater incentive to experiment and improvement.

"We can therefore give only the records accompanying this report and call attention to the recent publication of a special study on the transverse test. The series of special tests promised us by our friends last year have finally failed us, but will be taken up in order just the same, as time permits. On the other hand, the work, as far as it has gone, has attracted wide attention in Europe as well as in this country, the hearty support and kindly criticisms of many investigators forming a gratifying acknowledgment of sincerity of purpose on our part. We wish to record the kindly services rendered the committee by the Pittsburg Testing Laboratory and the Riehle Bros.' Testing Machine Co., the former for their ready help on the chemical and physical work connected with the smaller sizes of the test bars, and the latter for the tests made on the largest sections, which ran far beyond the range of ordinary work.

"We are glad to note that impact testing is securing special attention at the hands of several testing experts. One small set of bars has been prepared by us for Prof. Hatt, of Purdue University, which he will test in conjunction with steel and iron specimens on his new machine for testing by impact bars which are at the same time under tensile or compressive strain.

"The American Foundrymen's Association has been specially complimented for its high standing on questions relating to cast iron by the appointment of one member of your committee on the special work of the American section of the International Association for Testing Materials on the investigation of the magnetic properties of iron and steel used for electrical purposes. The work of studying our foundry product for commercial uses is just beginning and the American Foundrymen's Association is certainly destined to take a most active part in it. It is to be regretted that the past year's results are so meager. There has not even been a sufficient amount of time available to elaborate the results already obtained. We feel, however, that you will readily pardon us, as you are all in exactly the same position and are assuredly happy to continue so for as long a time as possible."

[The two sets of bars on which partial results are given in the committee's report are known as Cast D and Cast E. The former is from chilled roll-iron, cold blast charcoal pig being used exclusively. Transverse bars only were cast, the set of 48 bars being furnished by J. S. Seaman. The set is spoken of as representing "a class of castings which must be capable of resisting enormous strains not only external, but especially those existing internally as a consequence of artificially chilling the surface and working at a high temperature." Cast E yielded 44 bars of sand roll iron. They illustrate "a class of castings which must resist great bending strains while in a heated condition, as for instance in rolls for structural and merchant material. This particular cast was part of the regular heat going into large sand rolls." The tables of results of the transverse tests in the case of the two sets are of the round and square bars in green sand and dry sand, none being machined.]

Report of the Standardizing Bureau.

Mr. West, chairman of the committee on standardized drillings, which has charge of the bureau for the distribution of drillings made a report indicating gratifying progress. It is greatly to the credit of the association that its efforts have been so successful, and that it has been able to accomplish what has been mooted for years among chemists without tangible results. The report begins:

"In rendering a report of the bureau's progress up to May 19, 1900, to this convention the committee would call attention to the subjoined list of subscribers, which show that the number of laboratories which have adopted the Association's standardized drillings has increased to 149. Two of these laboratories are in Germany, 1 in England, 2 in Australia, 1 in Nova Scotia, 3 in Canada and 140 in the United States." [The committee's comments will appear in our next issue.]

Secretary Penton paid a high tribute to the work of the two committees which had reported, mentioning particularly the labors of Dr. Moldenke and Mr. West, who had given time

and thought and labor to an extent that only the few closely conversant with their work could begin to appreciate. James S. Sterling, of Wilmington, Del., and W. A. Jones, of Chicago, seconded Mr. Penton's words of commendation and a motion expressing the association's thanks to Mr. West and Dr. Moldenke was carried unanimously.

TUESDAY AFTERNOON.

At the afternoon session on Tuesday the first paper was that of Dr. Edward Kirk, of Philadelphia, on

The Training of Foundry Chemists.

In it Dr. Kirk gave his views on the operation of the system under which chemistry is now applied to the operations of the foundry. He is of opinion that the chemist "should not only be given charge of the laboratory but should be given full charge of the cupola, the mixing and melting of irons, and be held responsible for the quality of iron at the spout. This is the practice in every foundry in which chemistry has been a real success." The training of the chemist, in the opinion of Dr. Kirk, should enable him to deliver iron at the cupola spout having any degree of hardness, softness and strength required in the various grades of work. We defer publication of Dr. Kirk's paper, together with Mr. West's written discussion of it, to our next issue.

The regularly scheduled paper of Thos. D. West on "Training Students in the Principles of Scientific and Commercial Founding," as printed in these columns last week was then read.

Discussion.

A number of members responded to the invitation to discuss the general question of the better training of future foundry managers, as brought up by the papers read. C. S. Bell was ready to agree heartily with nearly all that Mr. West's paper brought out. No mechanical trade is so entirely dependent upon the judgment of the operator as that of the founder. You might as well make an athlete from the study of books as to try to make a foundryman from an education in chemistry. College education is valuable to the foundryman—there is no dispute about that; but college education will no more make a foundryman than it will make an attorney or a physician or a minister. There must be a genius for founding in the man who successfully follows that work. Some people who want to, go by rule, but rules and principles and theory will not make a foundryman. All that the books contain or that the colleges give are vain without the genius for the foundry trade that is developed by hard work and everyday experience.

Dr. Moldenke agreed with Mr. Bell in the statement that training in schools does not insure success in foundry management. Take 100 young men and put them in the foundry; one may make a success. But if it takes 10 or 15 years of experience in the foundry to develop the genius for the work that is indispensable to success, how much better it would be if this can be compassed in two or three years, with the aid of the best scientific training. The foundrymen's associations have started the movement for the bringing together of the technical and the practical in the training of young men for a foundry career; what remains is to bring the matter to the attention of the colleges, so that a beginning may be made in a definite way. Take the practice of the foundry and the courses in metallurgy and put the two together; the result will be what we are after. Chemistry and judgment must be combined to get the results desired. Therefore it is not a chemist but a metallurgist that you want. The chemist's business is to get the mixture into the cupola and there he ends.

J. G. Sadlier, of Springfield, O., made a plea for a better recognition of the practical elements that enter into the question. Up to the present time he was inclined to believe chemistry had done as much harm as good, as applied to foundry problems. Close observation and careful attention to the business itself were the things needed to make the successful foundryman. He thought too much attention had been given to the small percentage of the metalloids contained in cast iron, rather than to the differences in iron itself that go back to the ores, and that are as pronounced as the differences between timbers—between hickory and pine. He cited various problems arising in every-day cupola practice and in other departments of foundry work, which cannot be solved in advance by anything the chemist may do. The speaker laid emphasis upon the carefully trained eye, as giving the best testimony a foundryman could have as to the conditions of the metal under varying heat treatment, etc.

Maj. Malcolm McDowell, of Chicago, told of the manner in which he had combined chemistry and metallurgy with the results of experiment and everyday work in the foundry, to develop valuable data as to the effects of the metalloids upon cast iron. Much of his experience had been in the foundries of New England, in lines of castings requiring strength and finish. He emphasized the value of chemistry and told how at one foundry where 8,000 tons of scrap had accumulated in the yard he had been able to work it all up, succeeding both in getting the quality of iron desired and getting it regularly, and at the same time in giving economies in production not before realized.

F. B. Farnsworth, of the McLagan Foundry Co., New Haven, told of some rather discouraging experience in the effort to supply talent for the foundry management of the future. He had been instrumental in having a number of works on foundry practice added to a library in his home city, and advised apprentices to get these works and prepare for positions calling for more than the ordinary molder's equipment. The effort was far from being appreciated, and there as little in the way of tangible results. While machine-shop apprentices join night classes in draughting, read books and take advantage of special opportunities for getting on in their work, there is little of this spirit among foundry apprentices. The speaker had hoped that his own son would aspire to a foundry career and had trained him with that in view, giving him opportunities both in technical school and in foundry; but the young man is to day a successful patent attorney in Washington and beyond any temptaption that the average foundry could offer. The trouble is, as the speaker had found, that young men who want to get ahead, are not attracted by the foundry; and the problem is yet to be solved of putting the foundry on such a footing as would cause it to attract bright and promising young men, in the way in which they are attracted by machine shops and engineering works and by steel works and blast furnaces.

Foundry Training by Technicnl Schools.

Following the above discussion Dr. Moldenke read the memorial sent by the Pittsburg Foundrymen's Association, through its committee consisting of Richard Moldenke, Wm. Yage, Thos. D. West, S. M. Rogers and F. H. Zimmers. It was stated that the paper had the endorsement also of the Philadelphia Foundrymen's Association and the New England Foundrymen's Association. It is as follows:

"The undersigned, a committee appointed by the Pittsburg Foundrymen's Associations, would respectfully memorialize the American Foundrymen's Association on behalf of the careful training of our coming foundry superintendents and managers for the duties they will be called upon to perform.

"When in a recent meeting of an association of foundrymen it was resolved 'that the industry had arrived at a point where there is a demand for managers properly trained in the principles of scientific and commercial founding, and that a representative body such as the American Foundrymen's Association be requested to draw the attention of institutions of learning in the country to this fact and urge them to take the necessary steps to supply the demand,' the case was stated in a very plain manner. We are indeed drawing near to that point when so much is expected of a foreman, chemist, superintendent or manager, that he cannot hope to obtain all the necessary knowledge by the ordinary process of growing up with his work and learning to do what his predecessors were wont to do. The introduction of chilled irons, the deceptions arising from fractures of high-pressure-made pig irons, the education of the buying public in matters relating to what castings should be, the systematizing and close calculations necessary to produce successfully, and finally the very necessary utilization of irons and scrap formerly considered out of the question, have combined to give the internal foundry economies quite a different aspect when compared with the conditions prevailing a decade ago.

"What will be the problem in founding we shall be called upon to overcome 20 years from now? Only a technical education in the broadest sense when combined with a thorough business training will fit the man who can profit by these to look forward into the uncertain future with equanimity.

Let us survey the wonderful resources of this expanding country of ours, and note the history of each and every metallic product. We will then see that slowly but surely scientific methods introduced by trained metallurgists are improving, if not altogether replacing, the early processes. We do not now hear of losses of heavy percentages of metal in slags, and where would nine-tenths of the paying properties be to day were it not for methods based on the recovery of such minute quantities of metal that old dump heaps may be said to be profitable mines. So we will find that science has changed the metallurgy of gold, silver, copper, lead, iron, etc., so radically that we are to day dealing with the raw metals in such enormous quantities and so uniformly excellent that a splendid series of industries has been built up to use them.

"When we realize that the production and manufacture of nearly everything metallic except cast iron is now practically in the hands of specially trained men, and that the foundry is beginning to feel this influence also, is it not wisdom to take advantage of existing knowledge and try to increase it for our benefit? We all expect our sons to follow our footsteps. When we send them to the universities to acquire the faculty of sound thinking, or to our great technical schools for a fund of knowledge unequalled in its variety and usefulness for daily life, why should they not begin to lay a good foundation for their future careers? The benefit of a sound technical training to a young man who must some day step into the active management of an industrial enterprise is incalculable. It is the object of this memorial to urge that a young man who is fitting himself for a foundry career be given an opportunity to acquire the principles underlying the successful production of foundry products before he actually enters routine work. He will thus avoid much costly experimenting when time is precious.

"How may institutions of learning attack the problem? Few of them have a corps of instructors sufficiently in touch with the foundry to meet the requirements. The most practical way would seem to be the enlargement of the regular course in metallurgy to embrace special instruction in foundry practice, supplemented by summer work and instruction in noted shops. A course in foundry practice could be given in the form of lectures by specialists in this branch of metallurgy who could also outline a series of experiments for purposes of instruction in collaboration with the regular professors where an institution possesses a small experimental foundry plant. It is quite certain that many of our institutions of learning will be glad to take up this question if so representative a body as the American Foundrymen's Association sees fit to recommend to them the establishment of courses to teach the principles of the art of founding. Our American universities have always risen to the occasion, and will not fail us in this instance. We, the undersigned, on behalf of our association, would therefore recommend the following:

"*Resolved*, That the American Foundrymen's Association would welcome a course of training in the principles and practice of founding to be established by our institutions of learning, whereby those of their students who expect to devote themselves to this line of work may be made more valuable to the industry."

The resolution with which the memorial ends was on motion adopted unanimously as the sense of the association.

Crystallization of Metals.

In the absence of the writer, Edward B. Gilmour, of Milwaukee, his paper of the above title was read by Thos. D. West, and follows herewith:

It is almost impossible to overrate the importance of this subject with reference to the designing of castings as no one can design a casting intelligently without a knowledge of the laws which are brought into play in the cooling of a casting. There are few subjects in the foundry business that have attracted so little attention and had so little written upon it, and the best information that we are possessed of has been got by bitter experience through castings becoming defective on account of bad designs.

I will endeavor in this brief article to give some incidents which have come under my notice. Before doing so it is necessary to refer to some of the laws which govern crystallization. What is understood by that term, in a general sense, is every operation, or process, whereby any body is made to pass from a liquid or gaseous state to a solid, and assume a definable and regular form (that is, in the grain). Crystallization is an accessory to slow separation. In metals this takes place in the process of cooling. All metals which are cast, when they change from a molten state into a solid, have crystals or molecules which rearrange themselves in a regular order, according to influences brought to bear upon them. The formation of these crystals depends on the constituent particles, and can only take place if the molecules possess perfect freedom of motion. Generally when a body passes from a liquid or gaseous state to a solid, the crystals will take a definite shape resembling an octahedron, or two four-sided pyramids united base to base. When the crystals are united in regular order all through the casting, without any weak planes, caused by the separation of the crystals and which only occurs on account of defective designs, a casting is at its strongest.

Faulty designs have been a source of great trouble to the founder, and in a great many instances he is blamed for putting inferior iron into the castings. A regular formula has been used by the designer, who calculated that iron of such dimensions was strong enough to carry the load required. The practical foundrymen, more especially the steel founders, are watching the designs of castings and making the necessary changes needed to producing strong and good castings. Professor Mallet says of the formation of crystals: "It is a law of molecular aggregation of crystalline solids that when their particles consolidate under the influence of heat in motion, their crystals arrange and group themselves with their principal axis in lines perpendicular to the cooling or heating surface of the solid, that is, in the direction of the heat wave in motion, which is the direction of least pressure with the mass. This is true whether in the case of heat passing from a previously fused solid in the act of cooling and crystallizing on consolidation, or of a solid not having a crystalline structure, but capable of assuming one upon its temperature being sufficiently raised by heat applied to its external surface, and so passing into it."

Cast iron is a crystalline material which in consolidating obeys the laws pretty perfectly, the lines of crystallization running perpendicular to the external surface or in the direction of the heat wave passing form the body in cooling, so that if there is not even thickness in construction the crystals will run towards the point of cooling first, and heavy parts being longer in cooling will be subjected to a very heavy strain, which will cause a weak plane diagonally right in the center of the heaviest part of the metal. Take, for instance, Fig 1, which is a cross-section of a slide-valve cylinder, right through the center of the exhaust the points marked a a show the usual method in making the casting, with regular, even fillets on the core and evenly rounded on the outside. The design looks all that could be desired at first sight, but in practice and theory it is unquestionably wrong, as the heavy body of metal at this place is longer in cooling than at each side, and the crystals are formed in opposite direction to each other, causing a weak plane where the ordinary observer would expect it to be strongest, when in reality it is the weakest part of the cylinder. With a number of castings of this design we had a troublesome experience. After the engines had been delivered and were running, in a great many instances the cylinders cracked at the point shown, and the first one that gave way caused a legal controversy on account of the quality of the metal. But when, with the repeated occurrences of these breakages, the builders' attention was drawn to the construction, the result was a change in design to Fig. 2, b b—which is in accordance with the laws of crystallization—and resulted in neutralizing all the hard epithets which buyer and founder usually shower upon each other under such circumstances. The difference in design and the change in the order of crystallization is readily seen in this illustration.

Fig. 3 shows an arrangement of crystals which causes a weak plane to run into the heavy part. Fig. 4 is an example of crystal arrangement which is very definite, and is of the strongest nature. Fig. 5 is a flat plate section with crystals following a regular order radiating from the inside, with the exception of a diagonal weak plane—which usually causes

the outer edges to raise up and make a twisted plate. In order to obviate this trouble it has been found expedient to cover the whole surface of the casting with about three or four inches of sand, afterwards take a rammer and strip the sand upon the diagonal lines, which will cause the casting to cool quicker at this point and change the crystals into a regular form throughout the casting. In no case should flat plates ever be cast with hard iron, for the reason that in hard iron the crystals are more pronounced than in soft iron. Fig. 6 is a round bar which shows the crystals all radiating from the center in regular order. Fig. 7 shows an arrangement of crystals in a set of building plates, which were made to strengthen the building of cylinder molds. We had a number of these castings to make, and our intention was to use the same plates for each mold, but they always split diagonally at the corner after the cylinder was cast. I therefore made a change in construction, which completely rearranged the crystals, as is demonstrated in Fig 8, and gave the desired result of saving them every time.

stronger castings because the crystals are better defined. However, this does not always make clean castings, so that after all the molder has got to use discretion in order to produce the best results.

Discussion.

The question was raised at the conclusion of the reading, whether Mr. Gilmour was correct in the statement in the next sentence to the last, that dull iron always makes stronger castings than iron poured hot. Mr. Bell had noticed that in pouring certain irons hot they made stronger castings than when poured dull It depends, he thought, largely upon the constituency of the iron. Mr. West questioned the statement of Mr. Gilmour but was not prepared to give reasons or assert a general principle He thought that the difficulty of keeping conditions constant in all other respects would make a trustworthy test as between dull and hot iron very hard to get. Mr. Seaman had gone into this question experimentally but had not arrived at any satisfactory conclusion. He had had

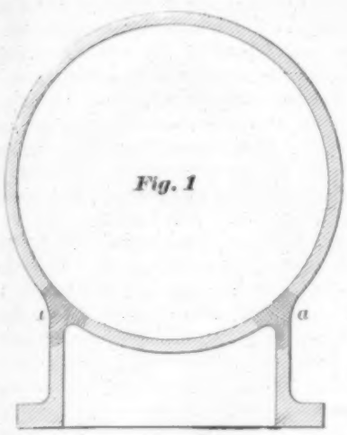


Fig. 1

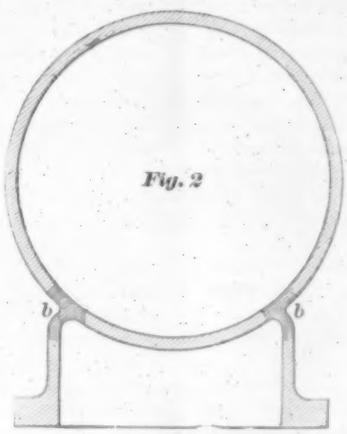


Fig. 2

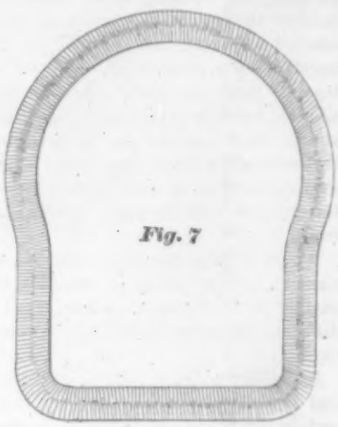


Fig. 7

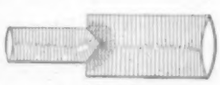


Fig. 3

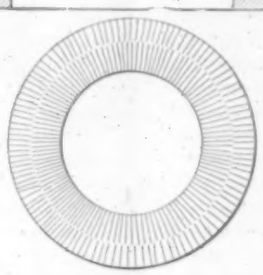


Fig. 4

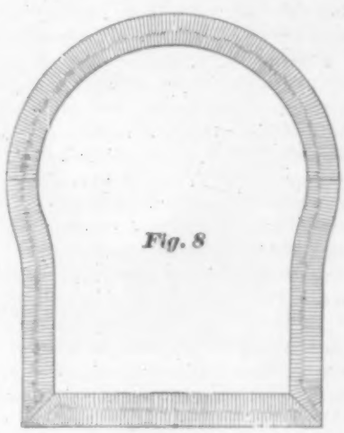


Fig. 8

Fig. 5

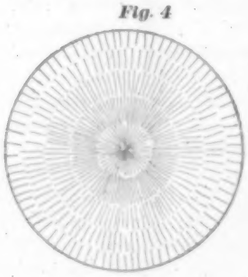


Fig. 6

CRYSTALLIZATION OF METALS.

It will be apparent from the illustrations that any one having charge of the designing of castings should give particular attention to such points as are set forth, and avoid all unequal thicknesses or sharp corners. It is time many castings may be made which will not show any particular defects in a marked degree, because if they are exposed to great heat the crystals will rearrange themselves, as has already been demonstrated, from the entering and returning of the heat waves, and the greater the heat the more easily will the above laws be obeyed. Consequently, if the designer is familiar therewith, the founder will be saved much money and time, also a great deal of anxiety and trouble. The molder before pouring his work should be cautioned to look after his iron and see that it is of the required temperature to suit the work; for the heavier the piece is the cooler should it be poured, as the development of crystals depends upon the regularity of the cooling of the casting, and dull iron always makes

a pyrometer at work, particularly in large castings and hoped to have more data than are now available.

Secretary Penton read the following paper on

The Mixing and Melting of Iron for Hydraulic Work,

by R. P. Cunningham, of Holyoke, Mass.:

The mixing of iron for castings used on hydraulic work, or any casting that is required to stand a great pressure, has never received the attention it should have by the average foundryman. It is a common occurrence in shops where hydraulic work is cast to have trouble with castings leaking. What I mean by that is, when the machine is put on the test it will not stand the pressure, and water will come through the casting. This is very aggravating, besides being very expensive, as the machine work is sometimes four times the cost of the casting; and to have the casting and the labor charged back to the foundry is something that the foreman does not

relish, and very often he is not to blame for the defective castings, as he had done everything he could, and the only blame that could be laid on him is that he should know his iron. If he had, the result would have been different. As it was, he tried to do the best he could with what he had, and his failure should be divided with those who compelled him to use iron entirely unfit for the work required.

In the best managed foundries the metal sometimes goes astray, and the unpleasant experiences which soon follow are decidedly painful. Often hundreds of dollars are lost; the foreman is called into the office and is shown letters from the firm's best customers, complaining about the castings; he is at a loss to understand the cause; his reputation is at stake. Upon investigation he is more confused than ever. Everything was conducted as usual; every rule he laid down had been followed; and yet these breaks occur, and are difficult of explanation. Every one admits that something is wrong, but how are we to locate the trouble? The answer is easy. Chemistry is your only relief, with its certainty of result. If you should want a nice piece of woodwork done, would you insist on using an inferior wood, or would you allow the woodworker to select the wood best suited for the work? If you wanted a special tool made, would you insist on your blacksmith using a cheap steel, or would you allow him the privilege of using his own judgment, and select the steel best adapted for this particular piece of work? The foundryman should know his iron as the woodworker knows his wood or the blacksmith knows his steel. He should be able to tell you at once the kind of iron required for any kind of work. This information can be easily obtained by an analysis of your irons.

We will take the six principal elements found in iron, namely, silicon, sulphur, phosphorus, manganese, combined carbon and graphitic carbon. Let us see what effect these different elements found in pig iron will have upon the castings.

Beginning with carbon: It has more influence on the physical characteristics of cast iron than any other; and within certain limits the influence of the various other elements are exerted not on the iron itself, but on the carbon. According to Fresenius there are four forms of carbon present in cast iron, but only two are well known, i.e., graphitic carbon and combined carbon. In the total carbons in any one iron there is not a great variation; but the effects of the relative amounts of the two on the strength and appearance of the iron are enormous. The higher the carbon, the weaker the iron. Graphitic carbon renders iron soft; but, owing to its disturbing elements, is low in tensile strength. Its disturbing continuity arises from the fact that it is simply an inter-molecular and not a true chemical combination, as is combined carbon. Iron high in combined carbon will have greater strength. The remelting will change graphitic carbon into combined carbon, and increase the strength and density of the iron.

Silicon. This element in iron is better known than any other. Its effect on foundry iron is that of a softener, i.e., it turns carbon into the graphitic state, owing to its great power over carbon, from which it is impossible to separate it. It is hard to tell just what its influence is on iron; but it is considered that anything above two per cent weakens the iron.

Sulphur turns graphitic carbon into the combined state, and makes the iron closer grained; but, in a casting with uneven thicknesses, is liable to crack it. This is overcome by melting the iron hotter, as the hotter the iron the lower the sulphur and graphitic carbon. A small amount of sulphur is not objectionable in iron used in casting hydraulic work, as an iron to show great strength and density should contain from 0.03 to 0.05 per cent. It should not be forgotten that coke contains a large amount of sulphur, and iron readily takes it up—and often the iron is condemned when the fault is with the coke. Therefore, one can readily see it is as necessary to know the analysis of your coke as your iron. It is a well-known fact that some of our best coke contains 0.50 per cent of sulphur, and some even higher. For this reason you should have the sulphur as low as possible in the iron.

Phosphorus. This element has a tendency to convert graphitic carbon into the combined state, but owing to the greater efficiency of silicon and sulphur its influence is not so marked. On account of fluidity and a tendency to overcome shrinkage it is valuable in iron used in hydraulic work, as in most cases with this class of work there is a large amount of cores and you are apt to have cold shuts unless the iron is very fluid. Another fact in this work is that the thickness is very uneven and liable to be porous unless the iron is fairly high in phosphorus, say from 0 50 to 0.80 per cent; but on light work it may run as high as 1 per cent.

Manganese, like sulphur, has a tendency to make iron harder and denser; but as most irons have very little of this element in their composition, not much attention has been paid to it—not as much as should be—for, owing to its chemical attraction for sulphur it serves to carry off much of this element which would otherwise combine with the iron, the sulphate passing off in slag. For hydraulic work, iron containing from 0.40 to 0.60 per cent can be used to an advantage.

We will take the castings used in hydraulic work. They must be sound, close-grained, and free from shrinkage. Only those that have had experience in this class of work know how difficult it is to accomplish. The exact chemical composition required in iron to produce the above castings should be determined and lived up to closely. It is only necessary to analyze your iron for the four principal elements, for it is a well known fact that iron high in silicon is low in sulphur; and when silicon is low, manganese is low and sulphur is high. In foundry irons you must watch the silicon, phosphorus and manganese in order to obtain satisfactory results. In summing up your mixture should contain from 1.25 to 1.50 per cent silicon; from 0.60 to 0.80 phosphorus; from 0.40 to 0 60 manganese, and sulphur as low as possible. If you will take that for your standard, melt your iron hot, you will see a decided improvement in the quality of your castings.

There is another point that must not be overlooked. In foundries using a large amount of scrap, say from 25 to 40 per cent, there is no fixed rule that you can adhere to. I always keep the scrap from the machine shop and sprews seprate, and use these in the first of the melt, pouring my best work from this iron. Take this in addition to what No. 1 scrap I can pick out of the outside scrap pile, and by letting the other go into the common iron, which I use only in work that is not required to stand a pressure and has little or no machine work on it. In doing this way it takes a little extra labor, but is more than offset by the quality of your castings. The care and management of the cupola is another point which should receive its share of attention. The mortar used in repairing the cupola should be mixed with great care. If the mortar should run in the cupola, the first iron would come hard and dirty. For this reason you cannot be too careful with your mortar. The different brands of iron and scrap should be thoroughly mixed in the cupola, and not thrown in at random. Each charge of coke should be put in even, and the whole kept as level as possible. The iron should be drawn into a large ladle, and from there into smaller ones. By doing this way your iron is thoroughly mixed, and good results obtained. I am no great advocate of seeing how little coke I can use in melting iron, for I claim more castings are lost by dull iron than any other way. An extra fifty pounds of coke on a charge will sometimes save hundreds of pounds of castings, especially in work that is thin in places and has a large amount of cores.

I have found by following these rules that I have increased the quality of my castings, and the per cent of good castings to the iron melted. In conclusion I will say that there may be others that have just as good, and perhaps better, ideas than I have advanced in this paper, and to those I will say, let us hear from you on this subject. I am open to criticism, as it is only in this way that we get each others' ideas. By doing so we raise the standard of foundry work.

WEDNESDAY'S TRIP TO SOUTH CHICAGO.

The excursion of Wednesday gave some idea of the immensity of the Chicago industrial district—a trip of an hour and a half on the Soo City bringing the visitors to South Chicago, still well within the circle of outlying hives of which Chicago is the center. At the docks of the Illinois Steel Co. a short distance up the Calumet river were seen the South Chicago method of unloading and storing ore, as already described in these columns—the elevated tracks; the long arms of the hoists that are let down into the vessel's hold; the two men at each track to dump the buckets into the ore car;

(Continued on page 28.)

Chicago Foundrymen and Committee Chairmen Whose Efforts Made the Foundrymen's Convention a Success.

P. W. GATES.

B. M. GARDNER. W. A. JONES. C. J. WOLFF.

M. C. ARMOUR. H. H. ROBERTS. B. T. BACON.

W. J. CHALMERS.

OPEN-HEARTH STEEL CASTINGS.

BY E. C. WHEELER.

The advances that are being made in the steel casting industry are much more satisfactory than those attending any of the various developments of iron. Malleable cast iron has also progressed wonderfully; yet while the product has been brought up to a high standard, the manufacturer is yet to be found who will guarantee his metal heat after heat, as is most necessary in the instance of steel. Steel is of course a strictly higher grade of metal than the others, from the fact that it will adapt itself to any condition attainable in them, besides meeting demands under which cast and malleable iron fail, or could not be expected to hold their own. Of the three varieties of steel castings, viz., Bessemer, open-hearth and crucible, the open-hearth has been proved the most serviceable for all classes of work, and for many reasons. Bessemer has incorporated in its composition during production, an element which precludes homogeneity, for not enough time lapses from the completion of a blow until pouring molds in which to allow some reagent the opportunity of working out the surplus oxygen. In open-hearth this undesirable quality does not develop, for during the progress of the heat in the furnace all of the excess oxygen both of fuel gas, and that arising from the chemical reaction in the metal, has become volatilized, and thus passes off. A similar condition prevails during the manufacture of crucible steel.

The range of the steel casting is ever enlarging, and the question of the best general metal has been solved in the production of open-hearth. In electrical construction its peculiar adaptability has been demonstrated far beyond the ideas of early designers, and this great success has been attained in following out the many vantage points offered by a low carbon content. With the carbon high in steel the point of resistance has been very low, and a reverse condition is possible with low carbon. Specific gravity of the metal has much to do with these conditions, for in the denser metal of the higher carbons, the specific gravity will be found upon examination to be lower than in metal of low carbons, where the cystallization is large and open. In other words the resistance in higher carbons is lower on account of the fine granular construction; and in low carbons resistance is higher, because of the greater homogeneity possible, together with the increased size of crystals. The softer the steel the more favorable will be the specification for electrical work. In fact all motor frames and boxes, and heavier dynamo castings are usually specified as low as .12 carbon.

Steel is naturally a very sluggish metal, for the life which was contained in the pig iron of the burden has entirely disappeared, and for it has been substituted the heat of the furnace, or induced heat, which fact alone compels the using of all dried molds, and the casting being made under pressure. Steel chills almost immediately upon contact, and has absolutely no latent life of itself to follow the openings of the mold, when poured under natural or normal conditions. In the successful casting of motor boxes and frames, when patterns have been quite rangey, great credit is due to the individual melter, who brings his heat up to the conditions required, when casting ¼-inch sections. In the larger and heavier shapes met with in electrical work, the feature of segregation has yet to be satisfactorily overcome. A casting having shrinkage cavities of blow holes will not give efficiency in service. There are several causes for the presence of blow holes, one of which is that open-hearth castings are produced under an abnormal heat, which hastens the voltialization of carbon, but does not in turn admit of the proper elimination of the occluded gases, which are in evidence in steel more than in any other metal.

Open-hearth of the best quality is worked very slowly in the furnaces, though never under a low heat condition, and this is the one essential feature in melting—the ability to so regulate the gas and air supply that the heat is still maintained without scorching the metal, or melting the roofs of furnaces. An experienced man need but take one glance into a furnace to decide whether the air is doing its function. The volume of gas from producers and the pressure of the same is of course the mainstay, but gas is not the only essential component in the mixture. The admixture of air in the proper amount determines the duration of heat in furnace and also in a great measure, the quality of metal upon tapping. The excess of air introduced into furnace is never satisfactorily excluded from the metal, for steel while melting and working up is, like iron, an asorbent of all impurities directly in contact.

Another great point in furnace working is the certain knowledge on the part of the melter of exactly when to make his test, and the time allowance after receiving analyses from the chemist before introducing the manganese. When the carbon is working down toward the desired figure—in the instance of steel for electrical uses, .18 to .20—a time when the furnace should be very hot, the rapidity of the chemist in returning analyses is very essential; for when the heat shows lower than, say, .12, and the melter endeavors to feed up with pig iron, he does not as a rule allow sufficient time to elapse for the total exclusion of the new carbon thus introduced. This new element, moreover, is never uniformly distributed, and almost invariably accounts for hard spots found in castings, besides holding sufficient carbon in suspension to produce a very undesirable metal. A heat should be allowed to come along slowly and naturally, so to speak, and if it should be found necessary to "feed up" after the charge is melted there is some feature overlooked either in calculation of burden or heat manipulation. The very best metal is that which is not tampere wdith in any manner until the addition is made of the manganese, at the conclusion of furnace treatment.

Another furnace defect is prominent when the endeavor is made to operate after the bottom has become fouled. This has always proved fatal, whenever the risk has been taken. There will be incorporated in the metal the gases which arise from the porosity of the bottom together with the excess of silica then prominent and fusible. When the bottom is in this condition the heat will work up just as quickly as when indications are favorable, but there will also be present the ever tell-tale quality of slag, which will show an absolutely dull appearance, denoting excess oxide of iron, infusible and detracting greatly from the life and fluidity of the metal.

Again, in the recarburizing with manganese the proper proportion, ton for ton, cannot be ascertained by any set rule. Rather it is the result of investigation based wholly upon the condition of the furnace, class of work under way, and the knowledge of characteristics present in the pig iron. An overdose of manganese will counteract all the previous good work of the furnace. In the molds to be cast will be found other causes for blowing and dirt in castings. Here there must be prevalent favorable conditions, some of which are perfect drying and sufficient vents to carry off the air and gases in the molds, which are excluded by the metals during pouring. A damp mold will generate gas instantly, and a mold which is perfectly dry, though cold, will also act in much the same manner. Molds should be warm, even hot, for the very best results of casting.

After a mold is poured and the ladle is taken away, if the shrinkers should be observed to be "bleeding," the cause is attributable either to defects in the metal or the mold. Under such circumstances the crane hands will often be seen pounding green sand on the shrinkers, endeavoring to chill the metal, a procedure which rather increases the malady, for if there should be any chance of redemption, it would be found by allowing the gas full chance to escape, rather than retarding it.

Perhaps the latest and most interesting field opened for steel casting has been in the building of the modern locomotive. This high speed machine must be of a light construction and in the heavier parts, where of old gray iron was dominant, cast steel is now specified. This has diminished the weight in the heavier parts at least one-third. The driving wheels are the principal castings on a locomotive, and the greater strength offered by steel, together with less weight, has appealed to designers at once. The specifications of two leading concerns are almost identical with one exception, which calls for the relieving of all internal strains, or annealing. The other concern does not mention this feature. It has been for some years an open question whether the reheating or annealing really affected the physical characteristics; but on positive evidence the writer knows that careful annealing not only relieves the internal strains, but materially advances the tensile strength and elongation. The

specific gravity and weight of castings is also increased to an appreciable degree, as the mechanical and chemical actions, which so completely change the complexion of the crystals, has affected the metal very greatly. It has been contended and very justly, too, that if steel castings are allowed to cool in the mold, there would be no need of further annealing, but in the instance of driving wheels and other large castings the unyielding nature of the molds compels that castings be freed from the mold when metal is thoroughly set, otherwise the lighter parts, as spokes, etc., would shrink or pull away from the hub. The rim of driving wheels, which was originally one continuous circle, has necessarily undergone some radical changes when patterns were to be molded for steel. The rim had to be split so that it would not pull away during cooling. The parts of the modern locomotive calling for steel castings are principally driving boxes, rocker shafts, cross heads, cylinder heads and saddles. The design of some cylinder heads presents a pattern the successful casting of which would be a credit to gray iron founding, not to mention steel casting. The physical specifications for railroad work call for tensile strength between 60,000 and 75,000, with an elongation of 15 per cent in 8 inches.

In the building of the modern steamships and men-of-war, parts which were once considered as impossibilities in steel are now molded with great ease. The stem and rudder-post, which were always made of forgings, and in several pieces, are now cast in one piece; in fact as far as range of work goes the metal may be forced to travel almost any length required. The writer has seen poured a rudder-post and frame for Cramp, the flasks for which measured 30x14 feet, and the greatest diameter of the casting was not over eight inches. It is rather difficult to say unequivocally that castings are on a plane of equality with forgings in marine work. The seeming superiority of the battleship Oregon, in which was incorporated such a large amount of forgings, is because in the absence of a steel casting concern upon the Western coast, forgings there were cheaper than the freight on same parts from the East. This latter fact offers quite a negative argument for steel castings.

One of the most difficult patterns has been that of hawse pipes for the new ships, which because of its peculiar construction entails molding in three parts. Propeller wheels have long since ceased to be a dread, although of late instead of casting a whole wheel, the blades have been molded separately and then bolted to the shaft. Should a blade become broken the wheel is not totally disabled, and this method also offers the great chance for repairs being made quickly. The turret gears and turning racks of late years have been cast of open-hearth, and these parts under service requirements are subjected to the greatest of shocks. There is yet, however, to be recorded a single instance of the parts failing in service. The greatest precaution must be maintained in the selection and treatment of all material entering into the composition of the metal, as phosphorus and silicon are greatly to be feared. In the basic open-hearth, phosphorus has ceased to be a detriment, as the dolomite lining has taken care of it by absorption. In the acid open-hearth furnace the only hope for final exclusion of phosphorus lies in the direction of some flux, yet to be named. Phosphorus makes steel "cold short," just as quickly as sulphur makes metal "red short," though with the slightly more favorable consideration that it does not always condemn the steel. Phosphorus is sometimes excusable, whereas sulphur is always barred.

Of course the great feature in all metallurgical operations is the final elimination of the carbon, and the approach to a chemically pure metal. The crystalline formation in open-hearth steel castings resembles greatly that which occurred in the original pig metal; in fact, it is almost a reproduction. The difference in chemical analysis would show primarily a loss of 3½ per cent carbon, together with varying amounts of the other metalloids. The great change in the two metals is quite noticeable, in the matter of resilience and cleavage, two properties not present in pig iron. The only explanation offered so far, for this great advantage of steel over iron has been from the fact that in following a law of metallurgy the lower the carbon the softer and more readily malleable will be the metal. This, however, has been but vaguely satisfactory. We might advance the theory that in the passing of the carbon the size of the molecules has been reduced, permitting of a very close contraction under pressure, or malleability, also great evenness in fracture. The individuality of the molecule is never destroyed in process; its size and formation, however, may undergo severe treatment, but the molecule disappears only in the volatilization of matter.

All the steel of commerce is primarily cast, and the same heat is capable of many and varying developments, according to the methods employed in working it up. The fluid compressed steel which enters so largely into armor plates, etc., is the direct result of mechanical rather than chemical reactions, for the scope of the latter really terminates when the metal ceases to be liquid. The mechanical treatment of open-hearth steel is the most expensive operation in metallurgy, for it requires the greatest of care combined with the most perfect working mechanical devices. Some idea of the cost may be gathered by the government limiting the cost of armor to $400 per ton. The question is now being debated very thoughtfully whether the operations are not over-intricate, and whether the same results cannot be obtained by shorter routes. The argument emphasized by the supporters of present methods is that too much care cannot be given this branch of the industry.

In 1887 the American Steel Casting Co. submitted to the government a 6-inch breech-loading rifle of open-hearth cast steel. The gun was cast at Chester, Pa., and to-day adorns the lawn in front of the office there, bearing this significant legend: "By Act of Congress." This gun was not submitted to any mechanical treatment after casting, and did successfully withstand the statutory test of 10 rounds, under service charges, with a velocity of 2,000 feet per second. There was a slight increase in the diameter of barrel after the tests, however, and the government board rejected the gun at once. There have been many comments passed upon the summary of this test, some of them not complimentary to the board, as its decision seemed to discourage other efforts in this direction. In 1898 this same company cast the jackets and tubes for the Brown segmental wire-wound gun, the success of which is yet to be pronounced, though the cause of any disappointment is not in the metal. Cast steel has never been given the opportunity to develop in this connection, as it is certainly entitled to do, since the history of earlier experiences still hovers near us, to the great prejudice of the metal. In ordnance, subsidiary castings, as gun-carriages, levers, and racers for disappearing stands, steel has entered one of its most successful fields, it being very doubtful if the substitution of forgings could have accomplished the desired ends with as great satisfaction.

The next development of steel castings will be the perfecting of process to allow of casting small shapes in green sand, thus obviating baked molds. At present all molds are baked in ovens and faced with pure silica to withstand the action of the molten metal. This is in itself very expensive when small "shapes" are being cast. The Tropenas process of cast steel has been introduced to overcome just the situation by producing a metal containing more latent energy than the open-hearth. This metal also possesses great carrying properties, more clearly described as fluidity. While the chemical composition does not vary greatly the mechanical treatment in the converters produces one of the hottest of steels. Tropenas castings in small shapes compare with forgings in every particular. There are several experimental plants already erected in this country, the process being introduced from Europe.

A class of work which has long been considered as undesirable for open-hearth steel is bridge work. There is perhaps no construction as vital to human interests as a bridge, and nothing of an uncertain quality should enter into its building. The designers of the new East River bridge at New York made a great advance for steel when it was specified for the anchor-plates throughout the structure. These plates varied in weight from 800 pounds to 15 tons, at which latter figure the bed plates were cast. These castings are all of a design which would have been considered extremely difficult when cast in gray iron, yet by keeping the carbon at .22 and pouring with metal not too hot all the anticipated troubles were obviated. The greatest trouble experienced was in making cores for the chambers for tie-plates. These chambers were so narrow and deep that in some instances the most carefully prepared core was turned into glass by the extreme heat encountered.

A great factor in favor of steel for bridge work is its great malleability in withstanding shocks and concussions, and also the decreased liability of cracking under the severest contractions of frost. The internal strains of metal during cold weather are most intense, and when the carbon is very high either as graphitic or combined, the pressures exerted toward centers are too great for the constitution of most metals. These strains are ever present until frost disappears, at which time the pressure is exerted from the interiors toward surfaces, due to the expansion of the molecules. But strains of this character are never as dangerous as contraction, for there is always room for its ready and necessary relief.

An Inertia Valve Percussive Tool.*—II.

BY CHESTER B. ALBREE.

[In our issue of May 24 appeared the first installment of this paper, of which the remainder is printed below. In the first part Mr. Albree discussed in general the advantages of compressed air over steam and traced the development of percussion engines and the methods of admitting power for percussive tools. Three types of these tools were described—the tappet valve type, the fluid moved valve type and the so-called valveless type. Then tracing the evolution of the pneumatic hammer, the writer came to the immediate subject of his investigations and experiments, detailed below.—ED.]

The Inertia Valve Hammer.

With this perhaps rather long examination of what has been accomplished in percussive tools, and study of the underlying principles, the subject of this paper, "An Inertia Valve Percussive Tool," will be discussed. Recalling the Darlington valveless rock drill and referring to the drawing (Fig. 1), we notice that when the rear edge F of the piston passes the exhaust port D on the back stroke, a cushion is at once started in the rear, increasing in pressure as the piston travels back. When the front of the piston passes and opens the entrance B of the by-pass B-C, initial pressure air flows through the admittance port M, the cylinder cavity and the by-pass to the rear of the piston, immediately checking any further movement and forcing the piston out, by reason of the greater area of surface F over surface A. In such forward movement, the edge A again closes the port B of the by-pass, cutting off the supply of further initial pressure air to the rear so that any additional pressure or force upon a rear area of the piston must be derived from the expansive action of the air locked in behind it, which is opposed by the initial pressure air bearing on the surface A which is constant at all points of the stroke, either forward or back.

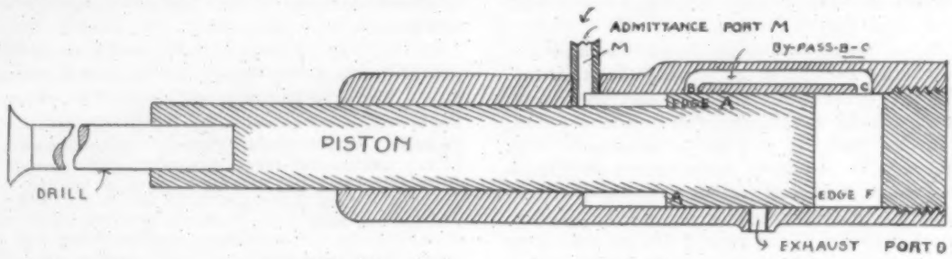


FIG. 1.—DARLINGTON ROCK DRILL, VALVELESS TYPE.

It seemed on study of this device that if some way could be found to allow air of initial pressure to follow up the piston during its entire downward stroke, much greater piston velocity would be secured. To accomplish this result it was obvious that an automatically moved valve of some sort must control the flow of air in such a way as to prevent any access to the rear during the back stroke and to permit such access during the forward stroke.

Poppet Valve Type.

The first solution that appeared was the use of a type of poppet valve (Fig. 2. Poppet valve, type No. 1) with a spring bearing upon it so that when there was no pressure on one side the valve would close under unbalanced pressure, but when the pressure was alike on each side the spring would force it open. To understand it clearly, referring to the spring, A is a port continually admitting air against the area E. G is a port leading from this area E to the valve chamber shown. C is a valve with a spring, D, bearing against the side of it that is away from the constant supply of initial pressure in the port G, arranged so that pressure against it from the port G will close it against the pressure of the spring when no pressure exists back of it. B is a by-pass having two outlets, H and h', communication with the cylinder. F is an exhaust port, adapted to be closed and opened by the rear edge of a piston. J is a guide to prevent the piston from turning, as the device as shown requires that the valve cavity should not come in contact with the exhaust port F.

In action air enters through A, pressing against the small area E, closes the valve G, and forces the piston back, the space in the rear of the piston and in the by-pass and valve cavity having exhausted through the port F. When the piston travels so that the edge E passes the port B air at high pressure goes through the by-pass to the rear, and at the same time through the port H into the valve cavity, thus equalizing the pressure on the sides of the valve C, which opens under the pressure of the spring D, permitting free passage of air through the port E, and the valve cavity, port H and by-pass to the rear, forcing the piston out owing to the excess area. As it travels out, this passage, either through B or H is continually open, so that a continuous current of air flows through the valve at initial pressure until the exhaust port is opened at F, reducing the pressure in the rear, when the valve again closes and the action is repeated as described.

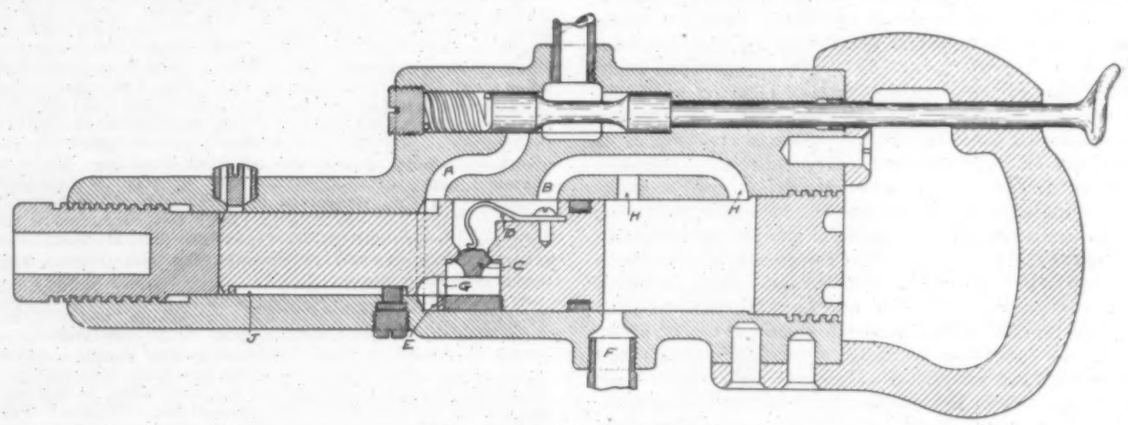


FIG. 2.—POPPET VALVE HAMMER.

This seemed very nice on paper and worked fair to middling badly. When the spring C was exactly right in intensity for a given air pressure it worked nicely, but any variation of pressure interfered with good results. Again the rush of air through the valve had had a strong tendency to close it, requiring a superfine adjustment of the intensity of the spring. For static pressures, the idea was all right, but for

*Read before the Engineers' Society of Western Pennsylvania, at Pittsburg, May 15, 1900.

dynamic pressures, if one could so call air under pressure in motion, it was not all that could have been desired.

In the line of simplicity and experiment a rearrangement of the parts was made as shown in the drawing (Fig. 3. Axial poppet valve). The poppet valve was placed in the axis of the piston, which did not then require guides to keep it from turning, and the construction was simpler. Results somewhat better than in the first machine were attained, but it was discovered that the inertia of the poppet valve interfered with the contemplated action of the device. This movement of the valve by inertia suggested the use of a form of slide valve that should be controlled entirely by inertia, opening and closing suitable ports in its travel to accomplish the desired ends.

Direct Acting Inertia Valve Type.

A tool as shown in the drawing (Fig. 4. Direct acting inertia valve diagram) was designed, having an axial hole in the center within which a small tube could move freely within fixed limits. A constant supply of air is admitted at 4 against a small area of piston. Ports 5–5 lead from a point adjacent to the small port into valve chamber, which in turn opens into the rear end of piston.

An exhaust port 14 leads through the cylinder and groove around the exterior of the piston, and communicates by a port 7 with the valve chamber. In starting, the tubular valve is at the outer end of chamber, thus closing ports 5–5 and leaving ports 7–7 open.

Owing to the constant pressure on the small area, and the exhaustion of pressure in rear of piston, it travels back, and the rear edge closes the exhaust port 14 which, however, registers at the same instant with annular groove on piston, establishing a new means of exhaust through the valve chamber, ports 7–7 and annular groove 8 to port 14. This passage remains open until groove 8 passes exhaust port 14, and the piston cuts off further exhaust, the cushion then commences which tends to check the velocity attained by the piston but not that of the valve carried thereby, and traveling with equal velocity. Being free to move, the valve slides back, until it meets stop 9.

In this position, the interior exhaust ports 7–7 are closed, the admittance ports 5–5 are opened, and initial pressure air flows through the valve to the space in rear, driving piston out by reason of the excess area. The valve remains in this back position, allowing air to flow through it, until the piston has struck its blow, when the valve slides, by reason of its inertia, to its outer position, and the action repeats as described.

It will be noticed that full pressure is exerted until after the piston has struck, and also that the valve will shift at any point during the out stroke, if the piston is stopped, provided that exhaust can occur. The possible limit of practicable variation of stroke is thus only limited by the distance found necessary to use for a rear cushion, to prevent the piston from ever striking the back cylinder head. This varies from one fourth to one third of a stroke length, thus permitting a wonderful variability. The tool as described worked very well at times, but it was discovered that the valve had a strong tendency to bounce back, especially on the front stroke. This unlooked for movement of the valve had very disastrous effects, as may be imagined, causing the action to be extremely erratic.

Expedients for Controlling Valve Motion.

To obviate this trouble, brakes were applied to the valve to prevent its sliding so easily. The machine ran well when it got a good start, but the valve was liable to stick at the wrong end of the chamber; there was great difficulty in starting again until the piston had been jarred by hand so as to bring the valve where it should have been. Other expedients, such as the use of rubber, lead, wood and other buffers supposed to be inelastic, were tried, in the endeavor to stop the bounce, with but little success, as anything soft enough to prevent bouncing was soon hammered out of all shape, the pieces clogging up the valve chamber. All sorts of shifts, profoundly wise and exceedingly foolish, met the same fate, until we were almost disheartened and disgusted with the perversity of things inanimate.

In pondering over the failure, the idea arose of counterbalancing the rebound of the valve by a smaller mass colliding with it at the instant rebound commenced. A little model was made, to show recoil and neutralization. It consisted of a pipe with two collars fastened to it, having between them another piece of pipe, large enough to slip freely on the outside of the other, and a little less in length than the distance between the collars. On holding this device about three or four feet above a block of steel, with the outer tube or rider, as it was named, bearing against the upper collar, it was dropped vertically. The lower end of the inner tube struck first, and started to rebound, but the rider, traveling at the velocity due to the fall, slipped over the main tube until it struck the lower collar, fast on the inner tube, thereby checking the upward velocity of the rebounding inner tube, so that the combination practically did not rise perceptibly from the steel block, landing almost as dead as a chunk of putty. It seemed as if this principle could be applied to the valve, so as to overcome its rebound and at the same time give the freedom of motion necessary to good action. A modification of the valve was made, with a rider attachment, which when tried caused the tool to work with the regularity of clock work.

In designing the valve and rider, a study was made of the

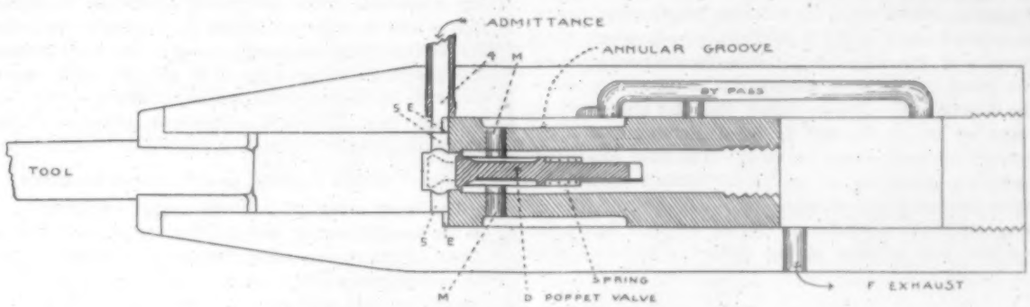


FIG. 3.—POPPET VALVE HAMMER NO. 2, CENTRAL VALVE.

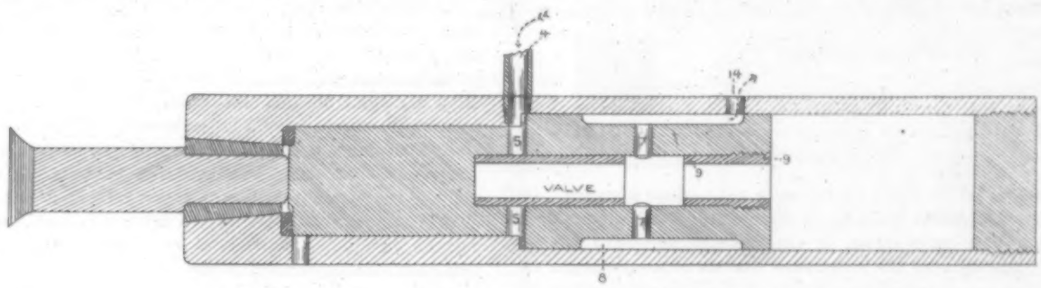


FIG. 4.—SIMPLEST TYPE OF INERTIA VALVE HAMMER, DIRECT ACTING.

co-efficients of rebound of various materials, and it was found that a great deal difference in results and theory existed among the acknowledged authorities on applied mechanics, authors of distinction such as Rankine, Weisbach and others giving tables with wide variations for similar materials. In order to be sure, recourse was had to experiment with different materials, to determine what proportion of weights the valve and rider should have to each other. It has been demonstrated by mathematicians that the relation of the elasticity to rebound is equal to the ratio of the relative bodies after and before impact.

Determining Modulus of Rebound.

If a body suspended from a small cord from a fixed point be made to oscillate like a pendulum (Fig. 5. Apparatus to determine modulus of elastic rebound), it will acquire velocity at its lowest point, proportional to the chord of the arc through which it has swung, and if the arcs are not very long, the times of descent will be equal for different length arcs; hence, if the suspended body strike a stationary body when at its lowest point, and the angular distance through which it rebounds be noted, the ratio of the original to the return velocity can be determined. It was found that for steel striking steel, it was as 100 to 60, and for steel striking vulcanized rubber backed by steel, about 100 to 37. The fibre was used, as it stands the pounding of the valve without itself disintegrating or upsetting end of valve.

Knowing then the modulus of recoil, we can figure the velocity a body will acquire at the instant after collision on

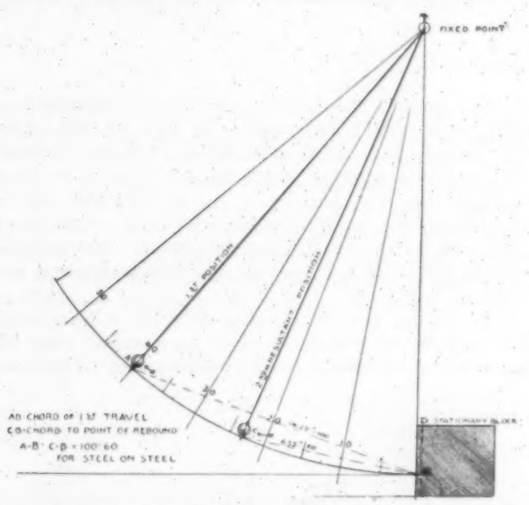


FIG. 5.—DIAGRAM OF APPARATUS TO DETERMINE MODULUS OF REBOUND.

the rebound, if we know the velocity with which it struck. If in addition we know the weight of a striking mass, we can find the energy or momentum at that instant, and have only to make the weight of the rider such that its momentum due to the initial velocity shall be equal to that of the valve rebounding, to practically eliminate the return movement of the valve. When two perfectly elastic bodies meet, each rebounds with substantially the same velocity with which they met, but with imperfectly elastic bodies of unequal masses and velocity, the rebound depends on which has the greater weight and velocity, hence we can approximately calculate the weight of rider so that the valve will stop short, and any rebound will occur in the rider only. This rebound can be made so little that it does not influence the valve itself and the desired result is attained.

In making these investigations certain interesting points came up that are worthy of further study to fully understand the reasons for them. The recoil certainly depends upon the elasticity of the colliding bodies, yet the ratios found by experiment seem to bear no recognizable relation to the established co-efficients of elasticity given in text books on the strength of materials. Evidently the amount of energy in the moving masses and the area of contact influence result. If the striking area be small the entire energy converted into work is exerted on a small unit of surface causing a strain per unit area greater than the materials would stand. In this case the limit of elasticity as ordinarily understood might be exceeded, when the work would be expended on tearing or crushing the material instead of causing rebound.

On the other hand, if a body of equal weight and velocity to the one described but having a much larger striking area, were to collide, it might easily be conceived that the strength per unit of striking area would be less than the limit of elasticity of the materials, and that practically most of such energy would be consumed in bending or squeezing the materials which would spring back to their original positions, and in so doing force the colliding body back into space with a velocity dependent upon the strain produced and the co-efficients of elasticity of the bodies.

To elucidate the proof of this hypothesis would require a great deal of careful experiment and research, and would be suitable work for some mechanical laboratory connected with a technical school. Accurate information on the subject would be of great value. It might originate a new method of testing materials, while somewhat analogous to impact testing that is now in vogue, although the results in the latter system are derived from measurements of bends made transversely in the specimen struck. By this method such results would probably be derived from a comparison with the velocities of rebound from standard substances, of bodies of given form, and with given velocity.

Direct Acting Inertia Valve Hammer.

The latest model of a direct acting chipping tool is shown in the accompanying sketch (Fig. 6. One-and-one-half-inch direct acting inertia valve hammer). You will note that the valve will move at any point of the stroke. If the velocity of piston be checked, and that within the limits for cushion described earlier in this paper, the stroke is variable.

While this variability of stroke is not so essential in a chipping hammer it is in a straight away tool or any tool of the second class of percussion, where an interposed tool receives the blow, yet for machines of the first class, such as rock drills, steam hammers, gold mine stamps, etc., such variability is desirable and essential for obtaining the best results. In this hammer the exhaust takes place at very nearly the initial pressure, hence a great deal of energy contained in the compressed air is wasted, although the piston velocity on the down stroke is great, giving a powerful blow. It seemed as if some of this waste might be obviated by working the air compound, using a different form of inertia valve so as to retain the good features of the device.

It was evident that a constant supply of initial pressure air should be furnished, available at any point of the stroke, but that it should have access to one end of the piston at certain specified times only and that the valves should permit of opening a passage from this side of the piston to the other, which necessarily should be of a larger area to allow of the locked-in charge of high pressure air acting expansively on both piston areas. It was also a condition that during the movement of the piston under initial pressure, that the other end of the cylinder should be open to exhaust in such a way that a certain amount of variability of stroke would result, and sufficient cushion formed to prevent piston striking cylinder head.

Compound Inertia Valve Hammer.

These conditions were fulfilled in a machine of the type shown in the illustration. (Fig. 7. Diagram of compound inertia valve hammer.) An annular groove was provided on a portion of the exterior of the piston that was in register at all points of the stroke with an admission port of high pressure air. An axial valve chamber was provided, open at the rear end in the body of the piston, having from it ports leading to the constant supply of motive fluids; other ports leading to a point adjacent to the small diameter of the piston, and exhaust ports, arranged so that exhaustion could occur through them during the majority of the back stroke, but closed by the motion of the piston for the remainder of the stroke. A tubular valve was placed in this central chamber, having on its exterior surface an annular groove, so placed that when the valve was at the outer end of its travel it would register with the ports from the constant source of supply, and the ports leading to smaller area, while at the same time a port throuhg it would permit of exhaustion.

In action the pressure against the small area of the piston drives it back, air in the rear meanwhile having a free vent

through the exhaust ports, until the piston in its travel cuts off the exterior exhaust port, thus cushioning the air remaining back of the piston and checking the velocity of the piston when the valve moves by its inertia to the rear end of its travel. In this back position the supply of high pressure air is cut off, as is also the exhaust port, and a port in the valve itself registers with a port leading to a small piston area, permitting the air locked in front of the piston free passage to the rear. The pressure immediately tends to equalize on both ends of the piston, and, owing to the larger area in the rear piston, is forced out under the force of the expanding air from the front end of the cylinder, continually decreasing in pressure as the piston moves, and the volume or space increases.

It is obvious that if the piston were back when at rest, there would be no locked-up air to expand, so that it could not start. To overcome this difficulty a spring is placed back of the piston, just strong enough to force it out when no air is admitted. No loss of power results, as the energy stored up in it on the back stroke is given out on the front stroke and it serves to help cushion.

The valve also is provided with a light spring, sufficient to keep it in the outer end of its travel when the piston is at rest, so that all will be in readiness to start on opening the throttle valve. The inertia of the valve on the down-stroke is sufficient, when the piston is constantly accelerating its velocity, to prevent this spring closing the valve prematurely.

The proportion of expansion can be determined if the clearances are known, for any ratio of piston areas. It has been found that for air, the proportion of 10 to 3 is good, as this gives a terminal exhaust pressure of about two pounds per square inch if 80 pounds were the initial pressure. This permits of prompt exhaustion and no vacuum is formed in the rear as would be the case if greater ratio of expansion were adopted. Such a ratio could be used with steam, as a condenser might be attached, but no experiments have been made in that line.

With this tool about three times as much work can be done with the same volume of air as with the direct acting tool, exhausting at initial pressure, or the same work can be done with one-third the volume of air. It may be seen that the diameters of the tool might have to be larger to effect these results, and that the mass of piston would be large in consequence. In practice a longer stroke has been adopted in order to avoid the back kick due to larger diameters, as explained earlier. The length of stroke does not affect the ratio of expansion, as the volumes in front and rear of piston change in definite proportion.

The velocities attained in forward and back strokes, in either the compound or single acting hammers, can be calculated with fair accuracy when the diameters, piston areas, pressure per square inch, length of stroke, and weight of piston are known, as these are constants or known variables. The amount of friction, leakage and loss due to inertia are difficult to determine exactly. Knowing the velocities and volumes of motive fluid per stroke, the total number of strokes per minute and total air consumption can be closely approximated; and in practice, count of the number of strokes and accurate measurement or air consumption by meter, check out within 5 to 10 per cent of the theoretical results figured. Thus a tool can be intelligently designed to do the work expected of it, as regards force of blow, frequency of stroke and air consumption at any given pressure.

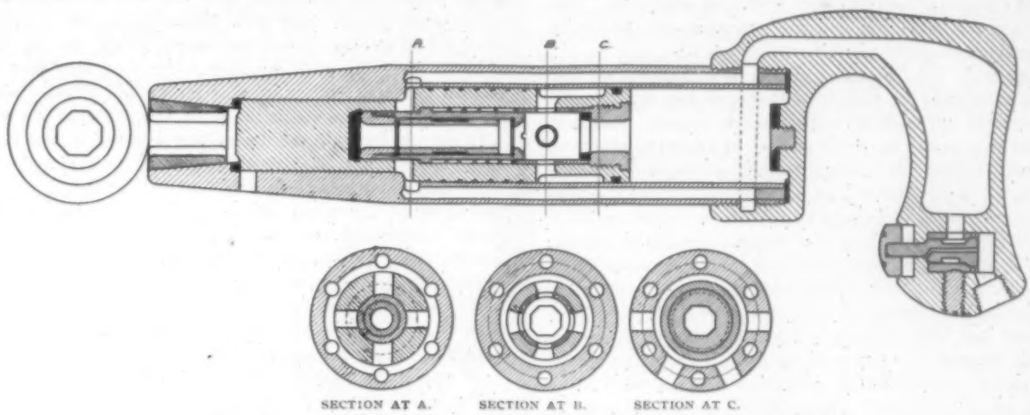


FIG. 6.—ONE-AND ONE-HALF INCH DIRECT ACTING INERTIA VALVE HAMMER.

This valve motion would be sure to be applicable to a great variety of purposes, even to running a compound engine with fair economy. The energy of stroke due to expansion is not 5 per cent less than that due to initial pressure. Machines can be designed to strike by initial pressure or expansive pressure as desired. The latter renders the construction somewhat simpler. The valve-motion rider attachment, poppet valve tool, and compound action are covered by patents. The tools run with regularity doing excellent work, and will shortly be placed on the market. Owing to the great numbe

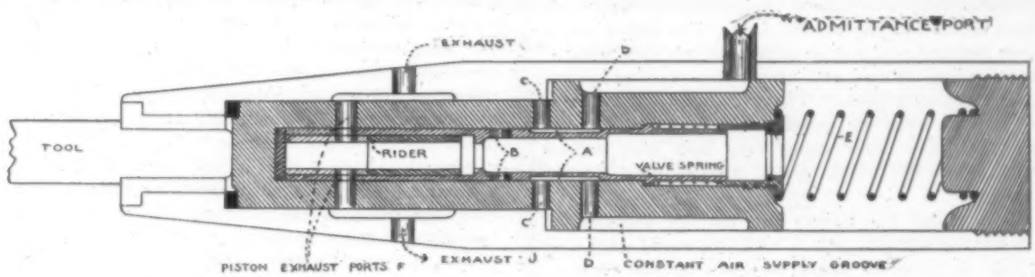


FIG. 7.—COMPOUND ACTING INERTIA VALVE HAMMER.

of strokes and the comparatively small piston diameters in the tools experimented with, it was found impossible to make reliable indicator tests, hence only by observation of the air consumption plus the number of strokes per minute and the general behavior of the tools could any data be obtained as to the performance of the valve and the probable pressures at different points of the stroke. The valve could not be seen when in action and only by reasoning from effects could hypotheses be made as to causes of good and bad action.

No. 2 furnace of the Alabama Consolidated Coal & Iron Co., Ironton, Ala., was blown in June 2, after an idleness of some months. Its capacity is 100 tons per day.

A temporary injunction was issued recently restraining the striking union men at Black & Genner's Stove Works, Erie, Pa., from interfering in any way with the men who are working.

CONVEYORS IN THE FOUNDRY.

BY DR. R. MOLDENKE.

Among the appliances which are destined to play a prominent part in the internal economy of the larger foundries, the conveyor will easily rank first. As a mechanical device it is designed to do away with manual labor in transporting material through comparatively short distances. Strictly speaking traveling and other cranes actuated by power would be conveyors, but the conventional meaning of the term limits it to that class of mechanical contrivances for carrying objects which act continuously.

On the well known principle that it pays to put in an improvement which promises 15 per cent, the management of a foundry enterprise can readily decide where to begin a more economical handling of its materials and products. It is a fact that in many otherwise well equipped shops the wheelbarrow and dump cart are still very much in evidence. The memoranda given below are intended to point out the places where conveyors could be used to advantage.

Beginning with the incoming of the raw material we will run across a number of foundries that will find it advisable to keep several carloads of coke always ahead. The best place to put this would be on or above the charging platform of the cupola house. A vertical bucket conveyor with open front, actuated by a motor and so arranged that the coke could be thrown upon it directly from the car would be much cheaper in the long run than the present method of unloading into a shed, wheeling to the elevator, or up a runway, and piling up as stock. If the coke bins are placed sufficiently high a very simple system of weighing and charging can be devised and but little platform room sacrificed. A similar system can be used for the molding sand. From the nature of the material the problem is somewhat simpler, sand being handled as easily as grain. Plain bucket conveyors running fairly rapid take the sand from the bottom of hoppers into which it is thrown from the car and lift it up as high as may be desired either into large storage tanks, or directly upon a platform for mixing with the old sand as this passes by in the distributing system that may have been installed. Ordinarily the molding sand question is serious only in crowded city locations and very large establishments.

The handling of pig iron requires more careful thought. We have to deal with very heavy and awkwardly shaped pieces. It is practically out of the question to store it in quantity above ground level. Piles must be kept separate and drawn from in exact quantities. The carrying systems applicable here would be those of transferring buggies loaded with fixed charges from metal pile to cupola door. The choice would rest between inclined planes with either endless wire ropes or single rope winding drums, and an electric traction system combined with ordinary hoists. The probability is that carrying machinery for handling metal would only pay in large foundries, the smaller ones doing very well with narrow gauge track, turntables and metal buggies handled by manual labor.

In foundries using the hearth furnace the question of charging is usually simpler. As a rule the metal yard is so arranged that a traveling crane can pick up the required mixture from the various piles and bring it directly to the charging platform, if there is one, or else place it upon metal trucks which can then put it within reach of the charging jib crane always present to handle heavy pieces. The foundry industry has hardly arrived at the point where a row of open-hearth furnaces of 25 tons or more capacity can be charged most economically by special machinery designed for the purpose.

Let us suppose the iron is ready to be tapped out, and a new series of operations will now confront us. The iron must be carried to the molds. Our present systems of pouring by crane, either jib or traveling, leave little to be desired when heavy work is to be handled economically. The light specialty foundry, however, can do wonders in rapid and labor-saving carrying of the melted iron by installing the proper distributing system. Two methods of handling moderate quantities of melted metal are in use. The simplest, though not the best, is to run buggy ladles of some thousands of pounds capacity under the cupola spout and catch enough iron to pour fairly heavy pieces, or else tilt into hand ladles. In this case the iron is trammed down the track either by hand or by electric motor. It requires a good clean track and suffers all the disadvantages of having the center of gravity near the top of the apparatus. The other method is to suspend ladles from an overhead track so arranged that iron may be caught directly at the cupola and poured into the molds. A variety of installations can be effected along these lines, each class of work and shop peculiarity requiring special treatment.

An altogether different line of carrying systems is that for handling molds before pouring. This is being looked into carefully at the present day, and about a dozen installations of this kind are already in existence. Molds may either be carried overhead or along the ground. The former system is good where the work is of an extremely delicate nature, and when it is heavy, compressed air hoists can be used to great advantage. Otherwise a plain endless rope system with small suspended platforms and the minor details adapted to the work answer very well. When the molds are carried on the ground greater care is necessary, as all jarring is to be avoided. A well built apparatus running very slow accomplishes this perfectly and may either be adapted for direct casting or have the molds taken off and parked for pouring.

In connection with mold carrying a more or less elaborate sand mixing and distributing system is usually installed. Here the reciprocating conveyor will be found the best, as the repeated shoveling over of the molding sand just wetted down tempers it perfectly so that when it drops into the molder's chute the work can be rammed up rapidly and well.

Perhaps the least studied portion of the foundryman's work, judging numerous examples, is the disposal of the castings after they are shaken out. We seldom see conveyors bringing them to the cleaning rooms, and yet with standard and especially small work this would pay very well indeed, for the wheelbarrow is a very expensive machine. The style of such a conveyor naturally depends upon the class of castings handled. Systems similar to those transporting bolts and nuts could be readily adapted for the purpose. The finishing processes often afford room for excellent carrying installations, especially where castings are machined in quantity and continuously.

Finally the carrying of coal may be briefly considered. Nearly all foundries use this form of fuel for boiler purposes, and many concerns find it necessary to make producer gas as well. In handling large quantities it is practically impossible to wheel the coal to boiler or producer platform with any show of economy. Large boiler and producer plants even have ash conveying equipments, as a rule combined with the refuse dump, the whole system emptying into cars. The simplest system is to drop the coal into pits; bucket elevators scoop up the lumps, reduced in size by passing through a grating or crusher if necessary, and take them up to elevated bins. These empty directly into automatic stokers in the case of boilers, and into the bell hoppers of producers.

From the above it will be seen that the conveyor is indeed a flexible piece of apparatus, being adaptable to practically every operation in the foundry. Every new plant of any consequence going up finds it profitable to embody some improvement directly connected with the handling of materials. It is due to our genius here in America more than in any other country of the civilized world that a marked cheapening of production has taken place, and the conveyor is one of the factors in this necessary movement.

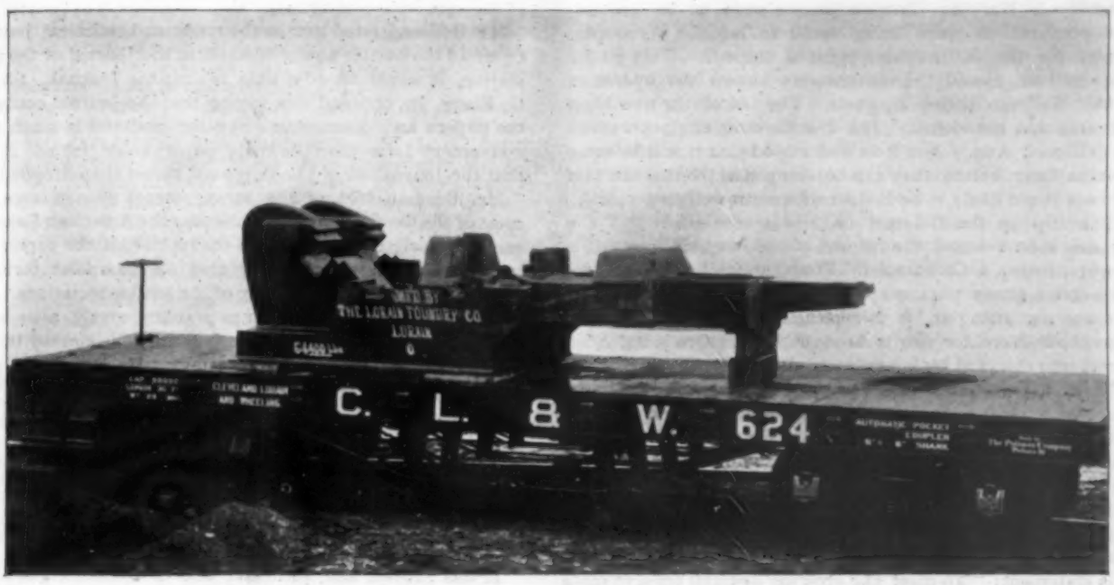
National Tube Co. Open-Hearth Plant.

Work will begin shortly on an extensive open-hearth plant which the National Tube Co. will erect at Benwood, W. Va., adjoining the blast furnaces, the by-product plant and the steel and pipe mills of the company's Riverside works. Purchases of land have been made in the past year, large additions to the Riverside site being required. The new plant will consist of six 50-ton furnaces, giving a capacity of about 5,000 tons a week. There will be erected also a continuous mill which will roll skelp for the Riverside and other plants of the company. The work will require nearly a year for its completion and the cost is estimated at about $2,000,000. The Wellman-Seaver Engineering Co., of Cleveland, has the engineering work in charge and is about letting the contracts for buildings and equipment. The Garrett-Cromwell Engineering Co., of Cleveland, will build the continuous mill.

LARGE CASTING FOR A NAIL MACHINE.

A recent product of the Lorain Foundry Co., whose plant at Lorain, O., is one of the best equipped in the Central West and probably has as great a range as any other in the kinds of work turned out, is shown in the accompanying half tone illustration. The casting which was made for a nail machine for the American Steel & Wire Co. is 21 feet 8 inches long, 6 feet 5 inches wide and 5 feet 1 inch high. The mold was made in green sand and skin dried. A green sand core was stood up the entire depth of the casting. The core was parted in the center, and the top half hung up in the upper cope, there being two copes, one above another, to lift over the step or jog in the casting.

The iron was melted in two nominally 20 ton air furnaces, and drawn out into four ladles, holding 8, 20, 8 and 6 tons respectively, in order of pouring. The fourth ladle was not used, being held in reserve for emergency The iron was poured from the bottom of the mold with two runners, a test bar showed 23 200 pounds tensile strength. The casting was allowed to cool for three days before being shaken out of the sand, and after cleaning showed no strain or swell whatever. The work was handled by two 30-ton Morgan electric cranes.



LARGE CASTING FOR A NAIL MACHINE.

The operations of the Lorain Foundry Co. are in charge of Oliver Phelps, general manager, and H. B. Davison, superintendent.

The Armor Plate Deadlock Broken.

After an amount of heated discussion scarcely paralleled on a measure involving the mere question of an appropriation for a single item of naval expenditure, Congress at last reached a conclusion on the armor plate question. Ever since the original attack upon the armor plate manufacturers in the Cleveland administration there has been a running fight upon the industry, and the unpatriotic attitude has been assumed by many members of Congress, of standing in the way of carrying out the programme of armament which was entered upon with such spirit immediately after the Cuban war. In the closing hours of the session the House conferees on the naval appropriation bill forced the Senate conferees to take out the provision for a $445 maximum for armor plate. The popular branch of Congress was evidently determined that the development of the Navy should not be checked by vindictive attempts to limit the cost of urgently needed armor to a figure which the manufacturers would not accept. The action finally taken was the adoption of Senator Penrose's amendment, which is as follows:

"That the Secretary of the Navy is hereby authorized to procure by contract armor of the best quality for any or all vessels above referred to, provided such contracts can be made at a price which, in his judgment, is reasonable and equitable; but in case he is unable to make contracts for armor under the above conditions he is hereby authorized and directed to procure a site for and to erect thereon a factory for the manufacture of armor, and the sum of $4 000,000 is hereby appropriated toward the erection of said factory."

The price limit being removed, it can be predicted with confidence that needed armor will be bought and that if Secretary Long will give the manufacturers a contract that will permit them to operate their plants steadily for months at a time, the price will be lower than has been possible under the spasmodic requisitions of the past 10 years. The proposition for a Government armor plate is a piece of folly which we do not expect to see consummated. Politics and patronage work harm enough in our army and navy, as it is, without giving them the chance to do their perfect work on the behind armor which our navy fights its battles."

The machinists' strike in the shops of the Cleveland Punch & Shear Works Co., of Cleveland, has been declared off and most of the old men have been taken back. The company shipped last week to New York for export one of the heavy angle shears in its line, having capacity to cut 7 x 7 x ⅞-inch angles cold. This shear weighed 30,000 pounds. The company has also shipped the first installment of tools on an order for the new plant of the Berlin Iron Bridge Co. at Economy, Pa., in the Pittsburg district. This entire order calls for two 48-inch and eight 26-inch punches and one rotary planer with 50-inch cutting head.

Concerning the closing down of the plant of the Danville Bessemer Co. at Danville, Pa., after running at a loss, President N. B Wittman said that the company had been required to purchase its new materials upon an ascending scale of prices and to market its products upon a descending scale.

The plant of the Missouri Furnace Co., St. Louis, is to be taken over by the St. Louis Blast Furnace Co., which have just filed application for incorporation. The furnace has a daily capacity of 150 tons. The incorporators of the St. Louis Blast Furnace Co. are Edwin C. Cushman, John D. Filley, Charles A. McNair, Arthur P. DeCamp and Wm. Yule. Capital stock, $200,000 paid up.

The Aluminum Brass & Bronze Co. and the Bridgeport Brass Co., of Bridgeport, Conn., have consolidated. The Aluminum Co.'s plant, which has been idle for six years, will start at once. It includes a rolling mill, wire machinery and a well equipped foundry.

The Globe Steel Range Co., of Kokomo, Ind., has increased its capital stock from $16,000 to $30,000.

AMERICAN FOUNDRYMEN'S ASSOCIATION.

(Continued from page 18.)

other men to push the car back and drop its contents into the railroad car below or farther back upon the ore piles in the extensive yards. On the opposite side of the slip from the ore yard, the company is erecting an experimental ore unloading plant designed by the Hoover bridge works, of Kansas City. It is intended for the unloading of ore into cars in which it will be taken to the Joliet works of the company. Led by C. H. McCullough the party made the tour of the blast furnaces and converter and rail mills. The plate mill, slabbing mill, open-hearth furnaces and a portion of the gas producers were idle for a little time for repairs. The rail mill was of special interest. At the 40-inch blooming mill the ingot was reduced in nine passes, requiring 42 seconds, to an 8x8 bloom. Seventy five pound rails were being rolled at the time, and the bloom was sheared into two pieces from one of which three rails were rolled and from the other two rails. The first roughing rolls and the finishing rolls were driven by a 54x66 inch Porter-Allen engine of 2,800 h. p. From the first roughing train the bar passed to the second roughing and dummy rolls, driven by a 44x66-inch Porter-Allen engine of 1,700 h. p. New engines also of Southwark Foundry & Machine Co. manufacture were on the ground, and preparations were being made to install a Weiss condenser for the entire steam plant of the mill. Though the plate mill was closed the visitors were shown the operation of the Wellman lifting magnets. The site of the new blast furnaces was not visited. The first blowing engines were to be delivered Aug. 1 but it is understood that it will be some months later before they can be completed, so that the first furnace is not likely to be in operation until well into 1901.

The trip up the Calumet river was continued and the steamer soon reached the furnace of the Iroquois Iron Co., a Rogers, Brown & Co. interest. Time enough was taken here to secure a group photograph. The foundations of the new furnace are rising and it is expected it will be ready by the time the first ore for 1901 is brought down. Ore is unloaded direct into the yard by a number of Brown rigs. During the visit at the Iroquois furnaces each member of the party received a folder and cigar holder containing cigars, with the compliments of the Iroquois Iron Co. The folder gave analyses of Nos. 1, 2 and 3 Iroquois, and of Sterling Scotch, Peerless and mill iron. The No. 1 contains 2.25 to 2.50 silicon, .30 to .40 phosphorus, .40 to .60 manganese and .02 to .05 sulphur. The No. 2 has 1.75 to 2.25 silicon, with the other elements the same as in No. 1. Appended to the analysis is this statement: "To meet the growing demand for a reliable graded iron we analyze and grade according to the foregoing table. After a year's experience we can positively state that iron graded by analysis regardless of fracture is a success. Each cast is analyzed from samples of the molten iron. No two casts are mixed in piling." The present annual capacity of the Iroquois furnace is 80,000 tons. When the furnace now building is completed this will be increased to 180,000 tons.

The trip also included a visit to the plant of the Chicago Shipbuilding Co., where several 475-ft. freighters were in various stages of completion. Among them was the barge Bryn Mawr of the Carnegie fleet, which was launched on Tuesday of this week. The machine shop of this company proved a place of great interest to the foundrymen. It is almost literally a glass house, and is of unusual height, for the complete erection of the marine engines which are its principal product. A noticeable feature was that the beds of all the large machine tools in the shop were painted white, and the whole place had an appearance of neatness and precise order that could only beget the habit of care and exactness in the operators of the tools. It was noticed that none of the machines were speeded to their utmost, accuracy, quality and finish being evidently studied rather than methods of hardest driving and deepest cuts of metal.

WEDNESDAY EVENING.

Theater tickets had been distributed to the visitors on the steamer trip in the afternoon, and at half after eight in the evening the Great Northern Hotel was deserted by the delegates, who scattered among the theaters. An entertainment by the Plumbago Club had been announced for 10:30, and shortly after that hour a number of the visitors gathered at a hall on North Clark street, where the Club held its peculiar festivities, presided over by the versatile J. D. Smith, of Cincinnati, who was assisted by S. T. Johnston, B. T. Bacon and others. The entertainment was in the nature of an informal smoker, with a vaudeville performance, the "turns" being interspersed with talks by Mr. Smith and his victims. The gathering broke up at a late hour.

THURSDAY MORNING.

The meeting was called to order by President Seaman at 10:30 A. M. The president asked for an expression of opinion as to the next place of holding the annual convention, for the guidance of the executive committee, and stated that any invitations from cities might be presented at that time. None were forthcoming, but Mr. Bell said that Boston, Buffalo and Cleveland were all candidates for the honor of entertaining the next convention. Dr. Moldenke suggested that it might be a good idea to hold the next convention at some resort, like Atlantic City or Lookout Mountain. He also expressed the opinion that the engagements might well be made so as to allow more time for the reading and discussion of papers than had been the rule heretofore, and that the entertainment given the guests should be of a less elaborate nature. The question of place for the next convention was left in the hands of the executive committee.

Mr. Bell suggested that as the trade and technical journals cover all the matter now published in the Journal of the association, it would be advisable to drop the Journal. Stanley G. Flagg, Jr., opposed this, saying that the Journal contained the papers and discussions and other material in much more convenient form than the trade papers could furnish it, and that the Journal should be improved rather than dropped.

Mr. Seaman told of the arrangements now in force with most of the local associations, whereby the American Foundrymen's Association furnishes to the former all the papers prepared by their members, printed in pamphlet form for distribution to the membership of the local associations. The latter then hold their meetings simultaneously, after which the papers are published in the Journal, followed by the discussions at all of the local meetings. He stated that plans had been formed for further bettering the service, and for making closer relations between the local and the American associations, and that the Journal is to be an important part of these plans. Dr. Moldenke suggested that the Journal might be published in unbound form, from time to time, at irregular intervals, as the secretary had material of any kind to furnish the members, each separate part so made as to be bound in one volume at the end of the year, thus forming complete transactions for the year of the association. This is as several other of the technical societies arrange the matter.

It was moved and seconded that a committee of five be appointed by the president to revise the by-laws and constitution of the association. After discussion this was adopted. The chair appointed on this committee Messrs. Brown, Keep, Moldenke, Bell and Jones.

C. J. Wolff, of the committee on nominations, announced the following: President, W. A. Jones, W. A. Jones Foundry & Machine Co., Chicago.

Secretary, Dr. R. G. G. Moldenke, Pennsylvania Malleable Co., Pittsburg.

Treasurer, Howard Evans, J. W. Paxson Co., Philadelphia, Pa.

Vice-presidents:—New England States, Geo. B. Buckingham, Arcade Malleable Iron & Steel Co., Worcester, Mass.; Middle States, Wm. Yagle, Wm. Yagle & Co., Pittsburg; Southern States, J. P. Golden, Golden Foundry & Machine Co., Columbus, Ga.; Central Western States, John A. Penton, Detroit, Mich.; Northwestern States, Wm. Ferguson, Wm. Ferguson Foundry Co., Chicago; Southwestern States, W. S. Mosher, Dallas, Tex.; Pacific States, R. Chartry, San Francisco, Cal. Canada, T. J. Best, Warder, King & Sons, Montreal.

On motion the secretary was instructed to cast a ballot for each of the nominees, and they were declared elected in due form.

Retiring President Seaman thanked the association for the honor it had given him, and introduced the new president, W. A. Jones, who made appropriate recognition of the association's bestowal and stated that it would be his aim to advance the interests of the American Foundrymen's Association in every way.

A vote of thanks was then given the retiring officers for their efficient services in the past year. Following the precedent of recent years, Dr. Moldenke moved that J. S. Seaman be made an honorary member of the association. Adopted.

A vote of thanks was tendered the Chicago foundrymen and the local committees of arrangements for the very elaborate entertainment given the association at this convention.

A vote of thanks was tendered the Illinois Steel Co., the

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Perhaps you're the man who pays the bills.

Men shovel coal and clean boilers just as reluctantly as other men pay big bills for coal—for cleaning boilers—for repairs to boilers—for new boilers.

As manufacturers of Feed-Water Heaters we take this occasion to remind you of what can be done in the way of **saving money** and **labor** by using the right kind of a Feed-Water Heater—a "COCHRANE," for example.

If the temperature of the water now being pumped into your boilers is less than 200° F.—say 180° or under—and there is any exhaust steam puffing out of your exhaust stack, then you are wasting money—and somebody has to shovel coal that need never have been bought. With the COCHRANE HEATER you would get 200° before any exhaust steam escaped, and from that up, depending upon your surplus exhaust. If your feed-water supply is not perfectly free from scale-forming matter, and yours is a closed or pressure heater, without a good OIL SEPARATOR in front of it, and a tank for holding the condensation, or a receiver pump for returning it direct to the boilers, then you're missing a glorious opportunity for keeping scale out of your boilers—and scale sticks to iron tighter than a burr to a dog's ear.

HARRISON SAFETY BOILER WORKS, Clearfield & 17th Sts., PHILA., PA.

Iroquois Iron Co. and the Chicago Shipbuilding Co. for the privileges given the members of the association at the works of these companies.

Mr. Penton mentioned the death of former vice-president C. A. Bauer, of Springfield, and paid a glowing tribute to his memory. On his motion a resolution was passed providing for a committee of five, which was made to consist of the three ex-presidents, the president and the ex-secretary, to draft suitable resolutions in this connection.

Owing to the limited time at the disposal of the convention, several papers which we will print later were read by title. These include: "The Real Fuel Ratio," by L. C. Jewett, North Attleboro, Mass; "What Are Improvements?" by Paul R. Ramp, Aurora, Ill.; "Flasks," by Eli H. Pearce, Baton Rouge, La., who died on May 10, and "Foundry Management," by Jas. A. Murphy, of Elizabeth, N. J.

The convention then adjourned sine die.

THURSDAY AFTERNOON.

Following the adjournment of the morning business session the convention was turned over to the Chicago entertainment committee, who announced a trip down the Drainage Canal of the Sanitary District of Chicago. The delegates took the Atchison, Topeka & Santa Fe train at noon for this trip, some of them accompanied by their ladies. The excursion occupied the entire afternoon, stops being made at points of interest along the canal, and at Lockport, where the canal waters are emptied into the Illinois River and carried through this and the Mississippi River to the Gulf of Mexico. The members were much interested in this vast engineering enterprise and especially in the great controlling works at Lockport. Refreshments were served on the train en route.

THURSDAY EVENING.

The smoker in the palm garden of the Great Northern Hotel, Thursday evening, was attended by almost all of the visitors and by a large number of the local foundrymen who had been unable to be present at the previous meetings and entertainments. The program was most excellent, high class talent having been secured from various vaudeville performances at the theatres in Chicago, and the entertainment lasted until a late hour. Refreshments were served during the progress of the vaudeville.

INDUSTRIAL SUMMARY.

The Empire Rolling Mill Co. will soon break ground for its new plant in Newburg, Cleveland. The boilers will be furnished by the J. C. McNeil Boiler Works, Akron, O., and will be of the Cook waste heat type, aggregating 600 horse power. The engines have been purchased. John D. Patton and Mr. James, for some years with the Cleveland Rolling Mill Co., are the promoters. Mr. James resigns as purchasing agent with the American Steel & Wire Co. July 1.

The Eatonton Shoe Factory, Eatonton, Ga., wants an electric or gasoline engine for its factory.

The Ohio Rolling Mills Co. started its mills at Findlay, O. June 3. New machinery has been installed throughout.

The first heat in the new Round Oak furnace plant at Dowagiac, Mich., was taken off May 29, consisting of 75 floors. Several new cranes are installed.

The American Steel Hoop Co.'s mill at Girard, O., resumed May 31. The Warren mill started June 3.

The Sligo Furnace of the Sligo Furnace Co., St. Louis, Mo., was blown in on June 2.

The Virginia Iron & Coal Co. has closed its Radford furnace near Bristol, Tenn., and the horseshoe works at Max Meadows, Tenn., for an indefinite period.

The factory and stock of the North Carolina & Virginia Wheel Co., near Richmond, Va., were destroyed by fire June 7. Loss, about $175,000; insurance $140,000. About 275 men are thrown out of work.

The entire plant of the Decatur (Ill.) Cutlery Works was burned June 7. Loss, $6,000.

Townsed & Duryea's machine shop on Scheuter's Island, New York Bay was destroyed by fire June 5. Loss, $60,000.

Col. T. G. Bush, president of the Alabama Consolidated Coal & Iron Co., says the Southern furnaces have their entire output sold to August 1. He believes consumers will be forced

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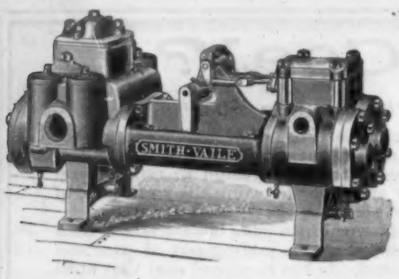

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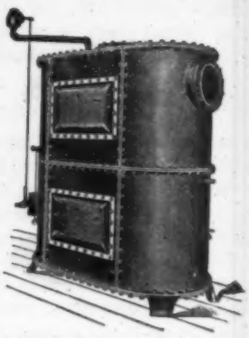

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into the market within the next 30 to 60 days, and that there will be no marked decline in prices from now on.

The report that the Brazil rolling mill at Brazil, Ind., would be removed to Terre Haute as a part of the Republic Co.'s plant there is denied.

The Kentucky Fire Brick Works, of Firebrick, Ky., is having an excellent trade. It is now working upon blast furnace linings for the Tennessee Coal, Iron & Railroad Co., the Alabama Consolidated Coal & Iron Co., the Sloss Sheffield Steel & Iron Co., the Red River Iron Co., and for furnaces for the Illinois Steel Co.

The Gleason Tool Works, Rochester, N. Y., have installed a 15-ton "Northern" electric crane, manufactured by the Northern Engineering Works, Detroit, Mich.

IRON FLASKS IN THE FOUNDRY.

There are a great many kinds of "new brooms" used in the foundry. Sometimes they take the shape of iron flasks; sometimes of sheet iron ladles, or cast iron ladles; of patent clamps, slag holes, high tuyeres, low tuyeres, high pressure and low pressure of blast; fan blower, or positive pressure blower, etc. And all of these "new brooms" sweep very cleanly for a time; but when they get a little aged we are apt to find that we have overrated the value of some of them.

The iron flask is by no means a new thing in the foundry—with the exception of some foundries. And its introduction into these sometimes leads to wasteful extravagance. The cast iron flask, used in its proper place, is simply perfection. And this fact sometimes fills the novice in their use with such enthusiasm that he will make up iron flasks for nearly everything in the shop, only to learn, with experience, that for half of them, wooden flasks would have been better. Then there are foundries where iron flasks are unknown, except by report. Some foundrymen denounce snap flasks, and never use one except under protest, while others employ them for all work to which they are properly adapted, and for many patterns where iron or wooden box flasks would be far more economical. A good rule for every foundryman to observe, in entering upon the use of a new device, is to go slow. Each of the three kinds of flasks spoken of is, in its proper place, the best possible; which is equivalent to saying that either in the proper place of the others is the worst possible. The man who has acquired his education by experience in a single foundry sometimes learns these truths with great cost to himself. If our readers will take the advice of a man who has learned by experience in a great many different foundries, always at the expense of somebody else: they shall have it, free.

If you have never used iron flasks, I advise you to begin to use them soon; but go slow. Make the flask exactly as you think you want it; but make only one flask—don't yield to the temptation to make up several of them at once—make just one. Things look very different in iron from what they do in wood. Possibly your first iron flask will be too light, but in most cases it will be entirely too heavy. Cut down the wood pattern and try again. One flask will be enough to make this time also; do not go ahead and make up a lot of flasks that should last for a lifetime without being sure that you are right. Use the flask a number of times, and get somewhat accustomed to it before making a stock of them. When satisfied that it is exactly right, go ahead.

You perhaps wonder why I am so insistent upon caution. If you had been compelled to use the iron flask product of as many different degrees of badness as I have run up against you would appreciate my anxiety in your behalf.

The depth of the flask is, of course, determined by the patterns to be molded in it. The thickness of the iron depends mostly upon the size of the flask, except that heavy work requires heavy flasks, large or small, within limits. For most

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flasks that can be handled by a single man, make the thickness from 3-16 inch to ¼ inch, average; the lesser for bench work, the greater for the floor. Large iron flasks must be heavier, and well fortified with flanges and ribs, to prevent spreading, working or sagging. Now, assuming that you are going to make up a set of iron flasks for the first time, one of the happiest opportunities of a lifetime is before you! A perfect flask is "a thing of beauty and a joy forever" in the foundry.

Do not attempt to make a set of flasks from wood patterns. They will spring and warp out of shape and the general results will be heartrending. Finish up a good set of iron patterns. On the joint edge of the cope, provide at least four clipping bosses ⅛ inch high. When you come to joint the cope and drag together if they do not exactly fit, a little trimming of one of these bosses will make all right, and, in molding these flasks, you have but to see that the places where the bosses rest are clear of obstructions in order to insure a tight joint between the sand of cope and drag.

There are numerous ways of making good handles on iron flasks, but in most cases a handle cast solid on the flask is as good as any, and it is by far the cheapest. It should be molded in a dry sand cove, the latter to be set against the pattern and rammed up in the mold. Hinges are far preferable to pins and plates where the copes may be rolled off and on. But in either case, make all copes and drags of a set of flasks interchangeable. To do this, you have simply to use the first flask made as a template, fitting all copes to the drag template and all drags to the cope template. Do not omit

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WHY?
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this—it will save you an immense amount of annoyance and labor in future, and it takes no more time to do it right than to do it wrong. I once worked in a foundry where they had several thousand iron flasks, each cope and drag fitted together separately, and numbered to correspond. A standard occupation was that of assorting copes and drags and matching them, and they never could straighten them out so fast as the workmen would mix them up. They have been using them for a decade, and they are still tangling and untangling them; and they will continue the process for a generation to come.

Now, if you make these flasks as about directed, you will be delighted with them, provided you have not made the mistake of making iron flasks for use where wooden box flasks or a snap flask would have served the purpose better. One must use his own judgment here. But there is not much danger of going wrong if only the judgment be brought into play before a start is made.—[E. H. Putnam in The Tradesman.

Tickets via Washington Over Pennsylvania Lines For Republican National Convention.

Two forms of excursion tickets to Philadelphia will be sold via Pennsylvania Lines for the Republican National Convention. One form will be good over direct route, the other via Washington. Fare will be the same either way, and tickets via Washington will be good to stop over at the National Capital.

June 14th to 18th, inclusive, are dates on which tickets will be sold. Ask Pennsylvania Lines Ticket Agents about them.

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Akron, Canton & Wheeling...	*10:30 A M	*3:30 P M
Akron, Canton & Chicago.....	*8:15 A M	*6:35 P M
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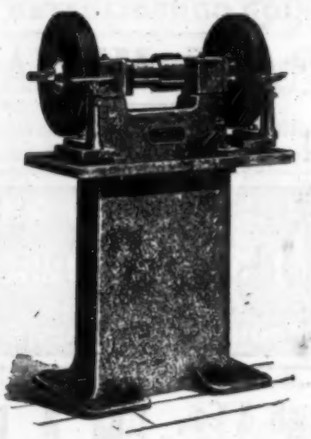

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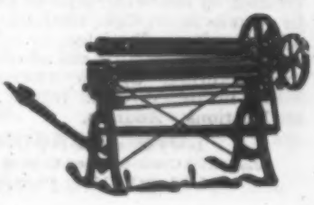

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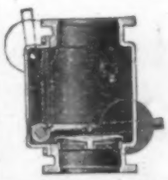

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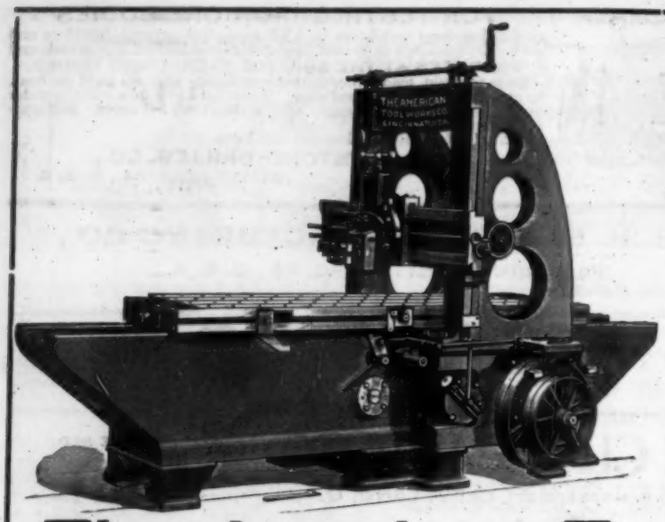

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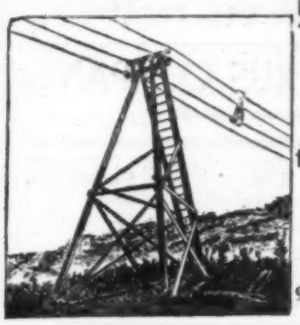

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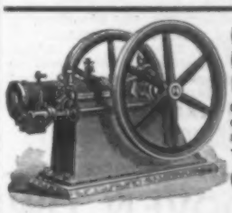

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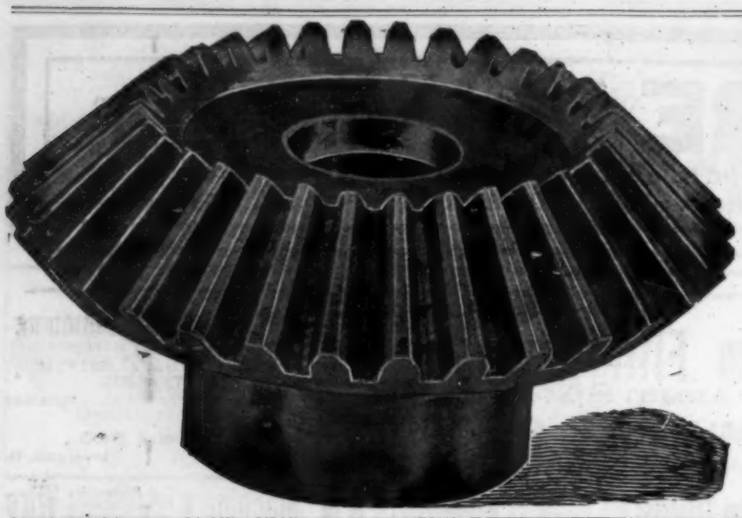

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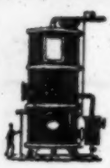

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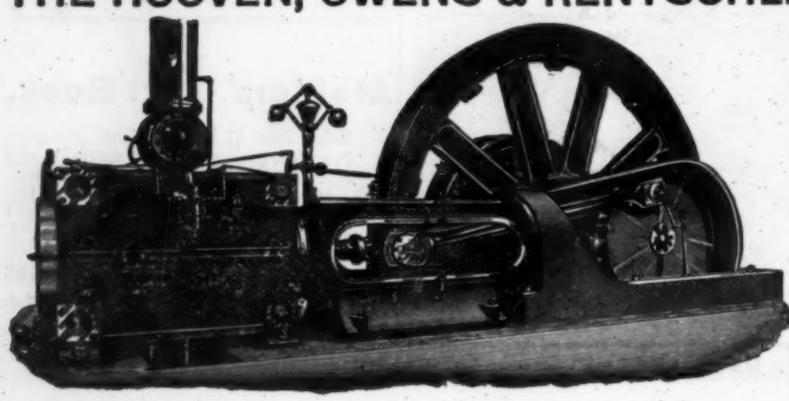

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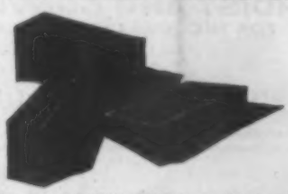

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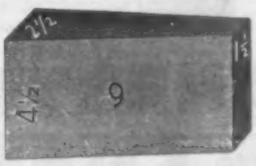

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The methods for analysis of iron ore, iron and steel and for assaying have been given briefly, but perhaps as much in detail as is consistent with the general scope of the book. Several changes and additions to the Specific Gravity tables have been made by adoption of later and more accurate values.

In the notes on blast furnace practice have been outlined the more important theoretical and practical points, which, it is hoped, will be of some service to those interested in the manufacture of iron.

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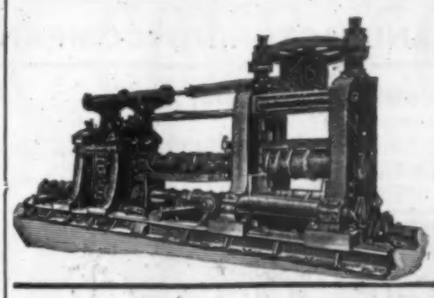

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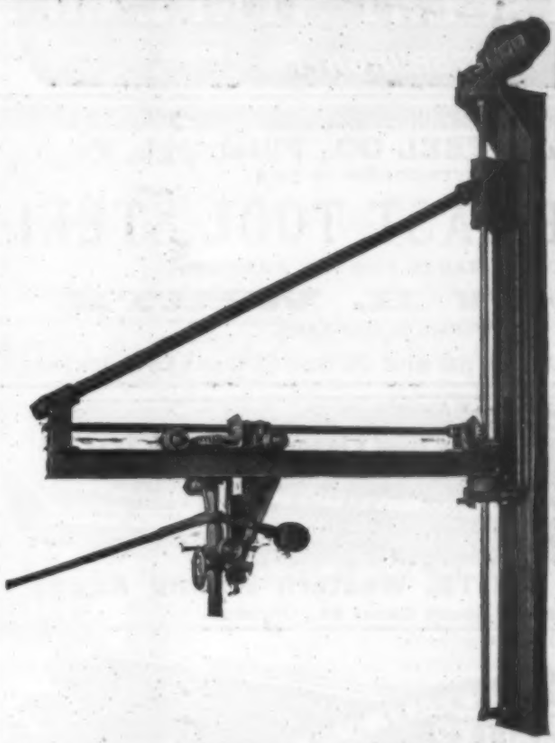

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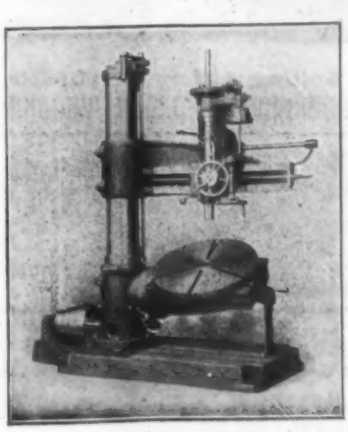

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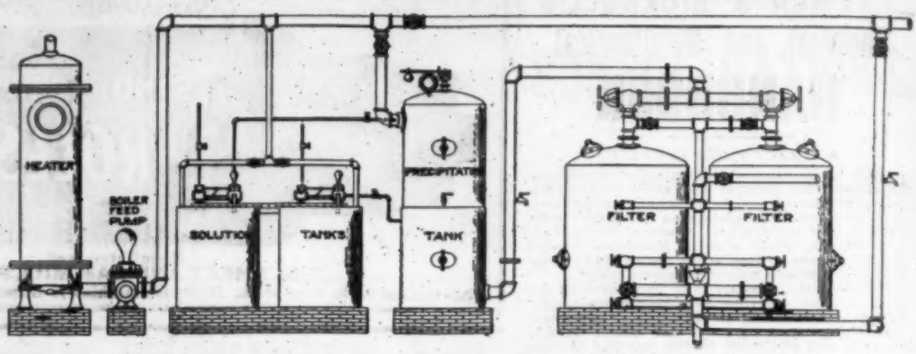

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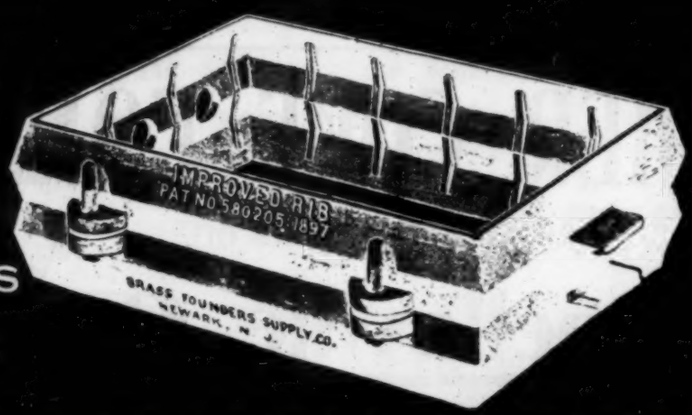

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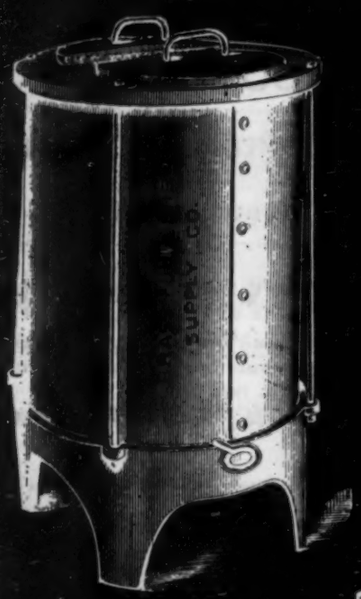

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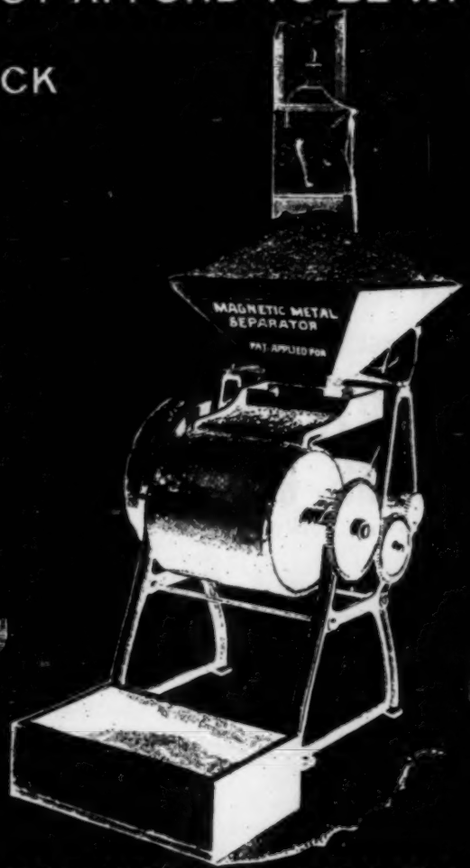

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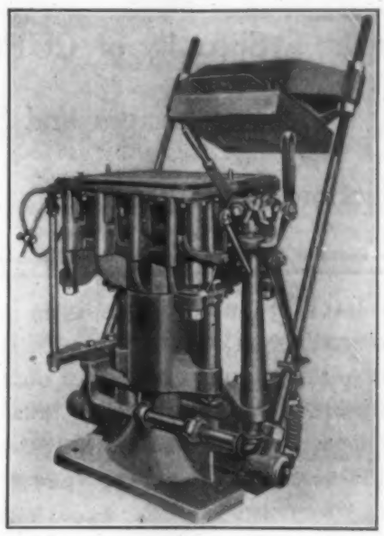

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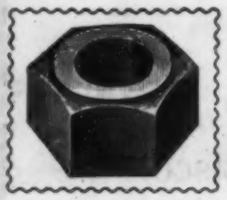

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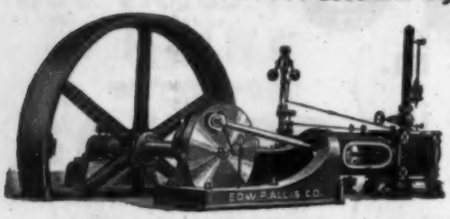

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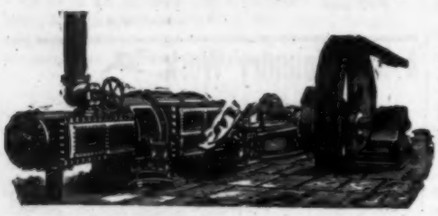

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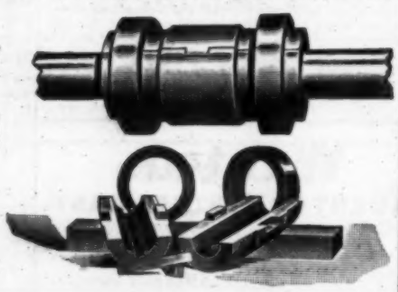

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Steam Engines, Shafting, Hangers, Pulleys, Sprockets Wheels, Chains, Etc., Etc.

Headquarters for Mill Gearing of all kind and sizes.
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The Edward P. Allis Co., Milwaukee, Wis.
Hooven, Owens & Rentschler Co., Hamilton, O
Harrison Safety Boiler Works Philadelphia.
Meehan Boiler & ConstructionCo.,Lowellville,O
Wm. Cramp & Sons, Philadelphia, Pa.
Riter-Conley Mfg. Co., Pittsburg, Pa.
The Aultman Co., Canton, O.
Fraser & Chalmers, Chicago, Ill.
James Bonar & Co., Pittsburgh, Pa.
The United Boiler Co., Girard, O.
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American Tool Works Co., Cincinnati, O.

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U. Baird Machinery Co., Pittsburg, Pa.
Bickford Drill and Tool Co., Cincinnati, O.
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Lorain Foundry Co., Lorain, O.

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Shiffler Bridge Co., Pittsburg.

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Wheeling Mold & Foundry Co., Wheeling, W. Va.
Lorain Foundry Co., Lorain, O.
West Penn Foundry & Machine Co., Avonmore, Pa
Link Belt Machinery Co., Chicago, Ill.
Massillon Iron & Steel Co., Chicago, Ill.

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CASTINGS (BRASS)—
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Lorain Foundry Co. Lorain. O.

CASTINGS (BRONZE)—
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CASTINGS (Steel)—
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Otis Steel Co., Cleveland, O.
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Bickford Drill & Tool Co., Cincinnati, O.
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Mossberg & Granville Mfg. Co., Providence, R. I

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Mossberg & Granville Mfg. Co., Providence, R. I.
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Julian Kennedy, Pittsburg, Pa.
Jeffrey Mfg. Co., Columbus, O.
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Chicago Fire Brick Co., Chicago, Ill.
Scioto Star Fire Brick Works, Portsmouth, O.
Kentucky Fire Brick Works, Portsmouth O.
Webster Fire Brick Co., South Webster, O.
Oak Hill Fire Brick & Coal Co., Oak Hill, O.
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J. & G. Obenberger, Milwaukee, Wis.
Pilling & Crane, Philadelphia, Pa.
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Brass Founders' Supply Co., Newark, N. J.
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Maywood Foundry & Machine Co., Chicago, Ill.

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Cleveland Crane & Car Co., Cleveland, O.
Thos. Furlow & Son, Philadelphia, Pa.
The Ohio Sand Co., Conneaut, O.
Union Mining Co., Mt. Savage, Md.
Dover Fire-Brick Co., Cleveland, O.
A. P. Smith & Co., New Brighton, Pa.
Tabor Mfg. Co., Elizabeth, N. J.
F. B. Stevens, Detroit, Mich.
W. H. Hawe Fire Brick Co., Mt. Union, Pa.
Cleveland Facing Mill Co., Cleveland, O.
Garden City Sand Co., Chicago, Ill.
Chicago Fire Brick Co., Chicago, Ill.
Brass Founders' Supply Co., Newark, N. J.
Vulcan Mfg. Co., Pittsburg, Pa.
Scioto Star Fire Brick Works, Portsmouth, O.
Kentucky Fire Brick Works, Portsmouth, O.
Webster Fire Brick Co., South Webster, O.
J. V. Rose, Sharon, Pa.
Oak Hill Fire Brick & Coal Co., Oak Hill, O.
F. B. Holmes & Co., Detroit, Mich.
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Maywood Foundry & Machine Co., Chicago, Ill.
A. J. Haws & Son, Johnstown, Pa.
Webster Foundry Sand Co., Philadelphia, Pa.

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Theo. Hiertz & Son, St. Louis, Mo.
C. H. Besly & Co., Chicago, Ill.
Swarts Metal Refining Co., Chicago, Ill.
Perfect Lubricating Metal Co., Cincinnati, O.
J. J. Ryan & Co., Chicago, Ill.
D. Clint Prescott Co., Chicago, Ill.

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GALVANIZED IRON—
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McCullough Iron Co., Wilmington, Del.

GALVANIZERS—
American Sheet Steel Co., New York City.

GALVANIZING POTS—
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Columbus Machine Co., Columbus, O.

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The Van Dorn & Dutton Co., Cleveland, O.
F. H. Bultman & Co , Cleveland, O.
Fraser & Chalmers, Chicago, Ill.
Southwark Foundry & Machine Co., Philadelphia, Pa.
James Bonar & Co., Pittsburg, Pa.
Nazel & Bassett, Philadelphia, Pa.
Link Belt Machinery Co., Chicago, Ill.

GEAR CUTTERS—
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GEAR CUTTING—
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The Van Dorn & Dutton Co., Cleveland, O.
F. H. Bultman & Co., Cleveland, O.

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Q & C Co., Chicago, Ill.
Cleveland Punch & Shear Wks. Co., Cleveland, O

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The Aultman Co., Canton, O.
Jones & Laughlins, Ltd., Pittsburg, Pa.
I. & E. Greenwald Co., Cincinnati, O
Link Belt Machinery Co. Chicago, Ill.

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James Bonar & Co., Pittsburg, Pa.
Wefugo Co., Cincinnati, O.
The United Boiler Co., Girard O
The Ideal Manufacturing Co., Buffalo, N. Y.

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C. H. Besly & Co., Chicago, Ill.

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Lidgerwood Mfg. Co., New York City.

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The Edward P. Allis Co., Milwaukee, Wis.
Lidgerwood Mfg. Co., New York City.
Exeter Machine Works, Pittston, Pa.
The Aultman Co., Canton, O.
Webster, Camp & Lane Machine Co., Akron, O.
J. & G. Obenberger, Milwaukee, Wis.

HOISTING MACHINERY—
Exeter Machine Works, Pittston, Pa.
Link-Belt Machinery Co., Chicago, Ill.
Jeffrey Mfg. Co., Columbus, O.
Lidgerwood Mfg. Co., New York City.
Heyl & Patterson, Pittsburg, Pa.
The Aultman Co., Canton, O.
The Brown Hoisting and Conveying Machine Co., Cleveland, O.
Webster, Camp & Lane Machine Co., Akron, O.
J. & G. Obenberger, Milwaukee, Wis.
A. Leschen & Sons Rope Co., St. Louis, Mo.

HOLLOW SHAFTING—
Atlantic Tube Co., Pittsburg, Pa.

HORSE SHOES—
Phoenix Horse Shoe Co., Joliet, Ill.

INDUSTRIAL CARS—
The Pressed Steel Car Co., Pittsburg, Pa.

INGOT MOLDS—
Lorain Foundry Co., Lorain, O.

INJECTORS—
C. H. Besly & Co., Chicago, Ill.
James Bonar & Co., Pittsburg, Pa.

INSURANCE COMPANIES—
Hartford Steam Boiler I. & I. Co., Hartford, Ct.

IRON BUILDINGS—
Illinois Steel Co., Chicago, Ill.
Schiffler Bridge Co., Pittsburg, Pa.
Riter-Conley Co., Pittsburg, Pa.
Wm. B. Scaife & Sons, Pittsburg, Pa.

IRON, NAILS AND STEEL—
C. H. Besly & Co., Chicago, Ill.
R. H. Stroud & Co., Chicago, Ill.

IRON AND STEEL ROOFING—
Berger Mfg. Co., Canton, O.
Wm. B. Scaife & Sons, Pittsburg, Pa.
McCullough Iron Co., Wilmington, Del.

IRON ORE—
Lake Superior Consolidated Iron Mines New York City, N. Y.
Oglebay, Norton & Co., Cleveland, O.
Pickands, Brown & Co., Chicago, Ill.
M. A. Hanna & Co., Cleveland, O.
Drake Bartow & Co., Cleveland, O.
Pickands, Mather & Co., Cleveland, O.
J. Wesley Pullman, Philadelphia, Pa.
Tod, Stambaugh & Co., Cleveland, O.
Jerome Keeley & Co., Philadelphia, Pa.

IRON WORKING TOOLS—
Avery Stamping Co., Cleveland, O.
American Tool Works Co., Cincinnati, O.
Cleveland Punch & Shear Wks. Co., Cleveland, O.
H. Bickford, Lakeport, N. H.
C. H. Besly & Co., Chicago, Ill.
U. Baird Machinery Co., Pittsburg, Pa.
Armstrong Bros. Tool Co., Chicago, Ill.
F. H. Bultman & Co., Cleveland, O.
The Armstrong Mfg. Co., Bridgeport, Conn.
Bickford Drill & Tool Co., Cincinnati, O.
Bertsch & Co., Cambridge City, Ind.

LADLES—
Northern Engineering Works, Detroit, Mich.
The United Boiler Co., Girard, O.
Wm. B. Pollock Co., Youngstown, O.

LAG SCREWS—
Vulcanus Forging Co., Cleveland, O.

LATHES—
U. Baird Machinery Co., Pittsburg Pa.
Bickford Drill & Tool Co., Cincinnati, O.
Danielson Machine & Tool Co., Cleveland, O.
American Tool Works Co., Cincinnati, O.

LINK BELTING—
The Jeffrey Mfg. Co., Columbus, O.
Link-Belt Machinery Co., Chicago, Ill.
Heyl & Patterson, Pittsburg, Pa.
The Aultman Co., Canton, O

LOCOMOTIVES—
Hyde Bros. & Co., Pittsburg, Pa

LUBRICANTS—
The Ironsides Co., Columbus, O.

MACHINISTS' TOOLS AND SUPPLIES—
American Tool Works Co., Cincinnati, O.
H. Bickford, Lakeport, N. H.
C. H. Besly & Co., Chicago, Ill.
U. Baird Machinery Co., Pittsburg, Pa.
Bertsch & Co., Cambridge City, Ind.
Armstrong Bros. Tool Co., Chicago, Ill.
Bickford Drill & Tool Co., Cincinnati, O.
Danielson Machine & Tool Co., Cleveland, O.
F. H. Bultman & Co., Cleveland, O.
Cleveland Punch & Shear Wks. Co., Cleveland, O.
Nazel & Bassett Philadelphia, Pa.

MACHINE SCREWS—
C. H. Besly & Co., Chicago, Ill.

MACHINE SHOPS—
The R. D. Nuttall Co., Allegheny, Pa.
Danielson Machine & Tool Co., Cleveland, O.

MACHINERY AND TOOL STEEL—
C. H. Besley & Co., Chicago, Ill.
Braeburn Steel Co., Braeburn, Pa.
Crescent Steel Co., Pittsburg, Pa.
La Belle Steel Co., Pittsburg, Pa
Byron H. White, Chicago, Ill.
Morris & Bailey Steel Co., Pittsburg, Pa.
Monongahela Iron & Steel Co., Pittsburg, Pa.

MAGNESIA COVERING—
C. H. Besly & Co., Chicago, Ill.
James B. Clow & Sons, Chicago, Ill.

MALLEABLE CASTINGS—
Acme Steel & Malleable Iron Works, Buffalo, N. Y.
Link Belt Machinery Co., Chicago, Ill.

MANILLA ROPE—
A. Leschen & Sons Rope Co., St. Louis, Mo.

MANILLA ROPE COATING—
The Ironsides Co., Columbus, O.

MANUFACTURING CHEMISTS—
The Ideal Manufacturing Co., Buffalo, N. Y.
Wefugo Co., Cincinnati, O.
Grasselli Chemical Co., Cleveland, O.

MANUFACTURED IRON AND STEEL—
Bourne-Fuller & Co., Cleveland, O.
Champion Iron & Steel Co., Muskegon, Mich.
The Morris & Bailey Steel Co., Pittsburg, Pa.
Cabeen Co., Philadelphia, Pa.
Republic Iron & Steel Co., Chicago, Ill.
Monongahela Iron & Steel Co., Pittsburg, Pa.
National Steel Co., New York City.

METAL BEARINGS—
Theo. Hiertz & Son, St. Louis, Mo.
C. H. Besly & Co. Chicago, Ill.
Perfect Lubricating Metal Co., Cincinnati, O.
Swarts Metal Refining Co., Chicago, Ills.
J. J. Ryan & Co., Chicago, Ill.
D. Clint Prescott Co., Chicago, Ill.

METAL CEILINGS—
Berger Manufacturing Co., Canton, O.

METAL WORK—
Avery Stamping Co., Cleveland, O.

MILL CASTINGS—
Schuykill Iron & Steel Co., Philadelphia, Pa.
A. Garrison Foundry Co., Pittsburg, Pa.

MILLING MACHINES—
American Tool Works Co., Cincinnati, O.
U. Baird Machinery Co., Pittsburg, Pa.
Danielson Machine & Tool Co., Cleveland, O.

MINING MACHINERY—
C. H. Besly & Co., Chicago, Ill.
The Edward P. Allis Co., Milwaukee, Wis.
Jeffrey Mfg. Co., Columbus, O.
Lidgerwood Mfg. Co., New York City.
Exeter Machine Works, Pittson, Pa
Wm. Cramp & Sons, Philadelphia, Pa
The Bucyrus Co., South Milwaukee, Wis.
Marion Steam Shovel Co., Marion, O.
Webster, Camp & Lane Machine Co., Akron, O.
Fraser & Chalmers, Chicago, Ill.
Wm. B. Pollock Co., Youngstown, O.
J. & G. Obenberger, Milwaukee, Wis.
Link Belt Machinery Co., Chicago, Ill.
Thew Automatic Shovel Co., Lorain, O.
A. Leschen & Sons Rope Co., St. Louis, Mo.

MINE PUMPS—
F. M. Prescott Steam Pump Co., Milwaukee, Wis.

MOLDING MACHINES—
Tabor Mfg. Co., Elizabeth, N. J.
Thos. Furlow & Son, Philadelphia, Pa.
Maywood Foundry & Machine Co., Chicago, Ill.

MOLDING SAND—
Ohio Sand Co., Conneaut, O.
F. B Stevens, Detroit, Mich.
Garden City Sand Co., Chicago, Ill.
Newport Sand Bank Co., Newport, Ky.
Webster Foundry Sand Co., Philadelphia, Pa.

MULTIPLE DRILLS—
Bickford Drill and Tool Co., Cincinnati, O.
Cleveland Punch & Shear Wks. Co., Cleveland, O

NICKEL PLATING OUTFITS—
Northampton Emery Wheel Co., Chicago, Ill.

NUTS (Self Locking)—
National Elastic Nut Co., Milwaukee, Wis.

NUTS AND BOLTS—
Upson Nut Co., Cleveland, O.
National Elastic Nut Co., Milwaukee, Wis.
Milton Manufacturing Co., Milton, Pa.

OILLESS BEARINGS—
C. H. Besly & Co., Chicago, Ill.

OIL BURNERS—
Rockwell Engineering Co., New York City.

OIL CUPS—
C. H. Besly & Co., Chicago, Ill.
James Bonar & Co., Pittsburg, Pa.

OIL FILTERS—
James Bonar & Co., Pittsburg, Pa.

OIL PUMPS—
C. H. Besly & Co., Chicago, Ill.

OIL STORAGE TANKS—
Wm. B. Pollock Co., Youngstown, O.

OIL SEPARATORS—
Harrison Safety Boiler Works, Philadelphia, Pa.
American Tool Works Co., Cincinnati, O.

OIL TANKS AND CARS—
Wm. B. Pollock Co., Youngstown, O.

ORE CARS—
The Pressed Steel Car Co. Pittsburg, Pa.

ORE CRUSHERS—
The Edward P. Allis Co., Milwaukee, Wis.
Jeffrey Mfg. Co., Columbus, O.
The Aultman Co., Canton, O.
Fraser & Chalmers Chicago, Ill.

ORE HANDLING MACHINERY—
A. Leschen & Sons Rope Co., St. Louis, Mo.

ORE SCREENS—
Rob't Aitchison Per. Metal Co., Chicago, Ill.
The Aultman Co., Canton, O.
Fraser & Chalmers, Chicago, Ill.
James Bonar & Co., Pittsburg, Pa.
Hendrick Mfg. Co., Carbondale, Pa.
Western Machinery & Supply Co., Chicago, Ill.

ORE TESTING MACHINERY—
Keystone Driller Co., Beaver Falls, Pa

PACKING—
C. H. Besly & Co., Chicago, Ill.
Jenkins Bros., New York City.
James B. Clow & Sons, Chicago, Ill.
A. Leschen & Sons Rope Co., St. Louis, Mo.

PAINT—
Iron Clad Paint Co., Cleveland, O.
Jos. Dixon Crucible Co., Jersey City, N. J.
The Ironsides Co., Columbus, O.

PATENT ATTORNEYS—
Wm. N. Cromwell, Washington, D. C.

PATTERN WORKS—
Gobeille Pattern Co., Cleveland O
Forsythe Pattern Works, Youngstown, O.
C. Birnbaum, Cleveland, O.

PERFORATED METALS—
Aitchison Perforated Metal Co., Chicago, Ill.
Fraser & Chalmers, Chicago, Ill.
Hendrick Mfg. Co., Carbondale, Pa.
Western Machinery & Supply Co., Chicago, Ill.

PIG IRON—
Cabeen Co., Philadelphia, Pa.
Rogers, Brown & Co., Cincinnati, O.
Reed F. Blair & Co., Pittsburg, Pa.
Clinton Iron & Steel Co., Pittsburg.
Bourne-Fuller Co. Cleveland, O.
M. A. Hanna & Co., Cleveland, O.
E. H. Stroud & Co., Chicago, Ill.
Pickands, Brown & Co., Chicago, Ill
F. B. Stevens, Detroit, Mich.
McKeefrey & Co., Leetonia, O.
Superior Charcoal Iron Co., Grand Rapids, Mich
Spearman Iron Co., Sharpsville, Pa.
Hickman, Williams & Co., Chicago, Ill,
Pickands, Mather & Co., Cleveland, O.
Republic Iron & Steel Co., Chicago, Ill.
American Steel Hoop Co., Pittsburg, Pa.
American Steel & Wire Co., Chicago, Ill,
J. H. Hillman & Son, Pittsburg, Pa.
C. R. Baird & Co., Philadelphia, Pa.
Pilling & Crane, Philadelphia, Pa.
Sloss Sheffield Steel & Iron Co., Birmingham, Ala
Sloss Iron & Steel Co, Birmingham, Ala.
Cherry Valley Iron Co., Pittsburg, Pa.
Jerome Keeley & Co., Philadelphia, Pa.

PIG IRON CASTING APPARATUS—
Heyl & Patterson, Pittsburg, Pa.

PIPE (CAST IRON)—
James B. Clow & Sons, Chicago, Ill.
Massillon Iron & Steel Co., Chicago, Ill.

PIPE (RIVETED STEEL)—
Wm. B. Scaife & Sons, Pittsburg, Pa.
Wm. B. Pollock Co., Youngstown, O.

PIPE COVERING—
C. H. Besly & Co., Chicago, Ill.
Jenkins Bros., New York City.

PIPE CUTTING AND THREADING MACHINES—
The Armstrong Mfg. Co., Bridgeport, Conn.

PISTON RODS—
Bethlehem Steel Co., So. Bethlehem, Pa.

PLANERS—
U. Baird Machinery Co., Pittsburg, Pa.
Bickford Drill & Tool Co., Cincinnati, O.
Danielson Machine & Tool Co., Cleveland, O
American Tool Works Co., Cincinnati, O.

PLATES—
Enterprise Boiler Co., Youngstown, O.
Republic Iron & Steel Co., Chcago, Ill.
Illinois Steel Co., Chicago, Ill.
W. W. Lindsay & Co., Philadelphia, Pa.

PLUMBERS' AND GAS FITTERS' SUPPLIES—
C. H. Besly & Co., Chicago, Ill.
James B. Clow & Sons, Chicago, Ill.

PNEUMATIC APPLIANCES—
Clayton Air Compressor Works, New York.
W. J. Schaefer & Co., New York City.

PORTABLE FORGE—
C. H. Besly & Co., Chicago, Ill.
Vulcan Mfg. Co., Pittsburg, Pa.

POWER DROP HAMMERS—
Mossberg & Granville Mfg. Co., Providence, R.I.

POWER PRESSES—
Avery Stamping Co., Cleveland, O.
Bertsch & Co., Cambridge City, Ind.
Cleveland Punch & Shear Wks. Co., Cleveland, O.
E. Konigslow & Bro. Cleveland, O.
Danielson Machine & Tool Co., Cleveland, O.
Mossberg & Granville Mfg. Co., Providence, R.I.

POWER TRANSMISSON MACHINERY—
Jeffrey Mfg. Co., Columbus, O.
E. A. Delano, Chicago, Ill.
Dodge Mfg. Co., Mishawaka, Ind.
The Aultman Co., Canton, O.
Jones & Laughlins, Ltd., Pittsburg, Pa.
I. & E. Greenwald Co., Cincinnati, O.
Link Belt Machinery Co., Chicago, Ill.
A. Leschen & Sons Rope Co., St. Louis, Mo.

PRESSES—
Bertsch & Co., Cambridge City, Ind.
C. H. Besly & Co., Chicago, Ill.
E. Konigslow & Bro. Cleveland, O.
Danielson Machine & Tool Co., Cleveland, O.
Avery Stamping Co., Cleveland, O.
Mossberg & Granville Mfg. Co., Providence, R.I.
Cleveland Punch & Shear Wks. Co., Cleveland, O.

PRESSURE GAUGES—
The Bristol Co., Waterbury, Conn.
James Bonar & Co., Pittsburg, Pa.

PULLEYS—
W. A. Jones Foundry Co., Chicago, Ill
E. A. Delano, Chicago, Ill.
Dodge Mfg. Co., Mishawaka, Ind.
The Aultman Co., Canton, O.
Jeffrey Mfg. Co., Columbus, O.
Jones & Laughlins, Ltd., Pittsburg, Pa
I. & E. Greenwald Co., Cincinnati, O.
Link Belt Machinery Co., Chicago, Ill.
A. Leschen & Sons Rope Co., St. Louis, Mo.

PUMPS (STEAM)—
The Edward P. Allis Co. Milwaukee, Wis
Blakeslee Mfg. Co., Du Quoin, Ill.
Fred M. Prescott Steam Pump Co., Milwaukee Wis.
Hall Steam Pump Co., Pittsburg, Pa.
Southwark Foundry & Machine Co., Philadelphia, Pa.
Stilwell-Bierce & Smith-Vaile Co., Dayton, O.

PUNCHES—
E. Konigslow & Bro. Cleveland, O.

PYROMETERS—
Edward Brown, Philadelphia, Pa.
Vulcan Mfg. Co., Pittsburg, Pa.

RADIAL DRILLS—
Bickford Drill and Tool Co., Cincinnati, O.
American Tool Works Co., Cincinnati, O.

RAILS—
Hyde Bros. & Co., Pittsburg, Pa.

RAILWAY SUPPLIES—
Cleveland City Forge & Iron Co., Cleveland, O.
Garden City Sand Co., Chicago, Ill.
Hyde Bros & Co., Pittsburg, Pa.

RAW HIDE GEARS—
Nasel & Bassett, Philadelphia, Pa.

RELAYING RAILS—
Hyde Bros. & Co., Pittsburg, Pa.

RIVETS—
Champion Rivet Co., Cleveland, O.
Jones & Laughlins, Ltd., Pittsburg, Pa.
Mahoning Manufacturing Co., Youngstown, O
Vulcanus Forging Co., Cleveland, O.

RIVETED STEEL PIPE—
The Wm. B. Pollock Co. Youngstown, O.

ROCK DRILLS—
Rand Drill Co., Chicago, Ill.
The Ingersoll-Sergeant Drill Co., New York.

ROLL FORGINGS—
Samuel Trethewey & Co., Pittsburg, Pa.
Frankford Steel & Forging Co., Philadelphia, Pa.

ROLLER BEARINGS—
Mossberg & Granville Mfg. Co., Providence, R.I.

ROLLING MILLS—
Mossberg & Granville Mfg. Co., Providence, R.I.

ROLLING MILL MACHINERY—
The United Boiler Co., Girard, O.
Totten & Hogg Iron and Steel Foundry Co., Pittsburg, Pa.
The Lloyd Booth Co., Youngstown, O.
Mossberg & Granville Mfg. Co., Providence, R.I.
West Penn Foundry & Machine Co., Avonmore, Pa.
Frank-Kneeland Machine Co., Pittsburg, Pa.
Turner, Vaughn & Taylor Co., Cuyahoga Falls, O
A. Garrison Foundry Co., Pittsburg, Pa.

ROOFS—
Shiffler Bridge Co., Pittsburg.
Riter-Conley Mfg. Co., Pittsburg, Pa
Wm. B. Scaife & Sons, Pittsburg, Pa.
McCullough Iron Co., Wilmington, Del.

ROPE—
A. Leschen & Sons Rope Co., St. Louis, Mo.

ROPE AND CORDAGE—
Waterbury Rope Co., New York City.
Link Belt Machinery Co., Chicago, Ill.

SAFETY WATER COLUMNS—
James Bonar & Co., Pittsburg, Pa.

SAWS—
Peter Gerlach & Co., Cleveland, O.

SCRAP IRON—
Hyde Bros. & Co., Pittsburg, Pa.
Illinois Steel Co., Chicago, Ill.

SCREENS FOR COAL, ORE, ETC.—
Robt Aitchison Perforated Metal Co., Chicago.
Hendrick Mfg. Co., Carbondale, Pa.
Jeffrey Mfg. Co., Columbus, O.
The Aultman Co., Canton, O.
Fraser & Chalmers, Chicago, Ill.
Western Machinery & Supply Co, Chicago, Ill.

SCREWS—
C. H. Besly & Co., Chicago, Ill.
Upson Nut Co., Cleveland, O.
Chicago Screw Co., Chicago, Ill

SCREW MACHINES—
American Tool Works Co., Cincinnati, O.

SECOND-HAND MACHINERY—
Hyde Bros & Co., Pittsburg, Pa.
Russell Machine Co., Pittsburg, Pa.
George H. Bowler, Cleveland, O.
Wm. W. Whitehead, Davenport, Iowa.
Brown & Zortman Machinery Co., Pittsburg, Pa.
Thos. P. Conard, Philadelphia, Pa.
The Atlas Machine Co., Pittsburg, Pa.
The W. J. Carlin Co., Pittsburg, Pa.

SENSITIVE DRILLS—
American Tool Works Co., Cincinnati, O.

SEPARATORS—
Harrison Safety Boiler Works, Philadelphia, Pa.
James Bonar & Co., Pittsburg, Pa.

SHAFTING—
E. A. Delano, Chicago, Ill.
Dodge Mfg. Co., Mishawaka, Ind.
Fitzsimmons & Co., Cleveland, O.
The Aultman Co., Canton, O.
Atlantic Tube Co., Pittsburg, Pa.
Jeffrey Mfg. Co., Columbus, O.
Jones & Laughlins, Ltd., Pittsburg, Pa
I. & E. Greenwald Co., Cincinnati, O.
Bethlehem Steel Co., South Bethlehem, Pa.
American Steel & Wire Co., Chicago, Ill.
Link Belt Machinery Co., Chicago, Ill.

SHAPE IRON AND STEEL—
W. W. Lindsay & Co., Philadelphia, Pa.

SHAPERS—
American Tool Works Co., Cincinnati, O.

SHEARING AND PUNCHING MACHINERY—
Bertsch & Co., Cambridge City, Ind.
Danielson Machine & Tool Co., Cleveland, O.
American Tool Works Co., Cincinnati, O.
Cleveland Punch & Shear Wks. Co., Cleveland, O.
Mossberg & Granville Mfg. Co., Providence, R.I.

SHEAR KNIVES—
Samuel Trethewey & Co., Pittsburg, Pa.

SHEET IRON AND STEEL—
E. H. Stroud & Co., Chicago, Ill.
Republic Iron & Steel Co., Chicago, Ill.
American Sheet Steel Co., New York City.
McCullough Iron Co., Wilmington, Del.

SHIP YARDS—
Wm. Cramp & Sons, Philadelphia, Pa.

SOLID STEEL SHEAR KNIVES—
Samuel Trethewey & Co., Pittsburg, Pa.

SPECIAL MACHINERY—
Cleveland Punch & Shear Wks. Co., Cleveland, O.
American Tool Works Co, Cincinnati, O.
James Bonar & Co., Pittsburg, Pa.
Avery Stamping Co., Cleveland, O.
Mossberg & Granville Mfg. Co., Providence, R.I.
Q & C Co., Chicago, Ill.
The Aultman Co., Canton, O.
Jeffrey Mfg. Co., Columbus, O.
E. Konigslow & Bro. Cleveland, O.
Wheeling Mold & Foundry Co., Wheeling, W. Va
Danielson Machine & Tool Co., Cleveland, O
Nasel & Bassett, Philadelphia, Pa.

STACKS—
Wm. B. Scaife & Sons, Pittsburg, Pa.

STAND PIPES—
The Wm. B. Pollock Co., Youngstown, O.
The United Boiler Co., Girard, O.

STEAM BOILER INSPECTORS—
Hartford Steam Boiler Inspection & Insurance Co., Hartford, Conn.

STEAM PIPE AND BOILER COVERING—
C. H. Besly & Co., Chicago Ill

STEAM PACKING—
James B. Clow & Sons, Chicago, Ill.
C. H. Besly & Co., Chicago, Ill.

STEAM PUMPS—
Hall Steam Pump Co., Pittsburg, Pa.
Blakeslee Mfg. Co., Du Quoin, Ill.
Fred. M. Prescott Steam Pump Co., Milwaukee, Wis.
Edw. P. Allis Co., Milwaukee, Wis.
Southwark Foundry and Machine Co., Philadelphia, Pa.
James Bonar & Co., Pittsburg, Pa.
Stilwell-Bierce & Smith-Vaile Co., Dayton, O.

STEAM SEPARATORS—
James Bonar & Co., Pittsburg, Pa.
Harrison Safety Boiler Works, Philadelphia, Pa
Wright Manufacturing Co., Cleveland, O.

STEAM SHOVELS AND DREDGES—
Marion Steam Shovel Co., Marion, O.
The Bucyrus Co., South Milwaukee, Wis.
The Thew Automatic Shovel Co., Lorain, O.

STEAM SPECIALTIES—
C. H. Besly & Co., Chicago, Ill.
James Bonar & Co., Pittsburg, Pa.

STEEL—
Otis Steel Co., Cleveland, O.
E. H. Stroud & Co., Chicago, Ill.
Braeburn Steel Co., Braeburn, Pa.
Cabeen Co., Philadelphia, Pa.
Champion Iron & Steel Co., Muskegon, Mich.
Crescent Steel Co., Pittsburg, Pa.
La Belle Steel Co., Pittsburg, Pa.
The Morris & Bailey Steel Co., Pittsburg, Pa.
Byron H. White, Chicago, Ill.
Monongahela Iron & Steel Co., Pittsburg, Pa.
American Steel Hoop Co., Pittsburg, Pa.
American Steel & Wire Co., Chicago, Ill.
C. R. Baird & Co., Philadelphia, Pa.
Aliquippa Steel Co., Pittsburg, Pa.

STEEL BANDS—
American Steel Hoop Co., Pittsburg, Pa.
American Steel & Wire Co Chicago, Ill.

STEEL BLOOMS AND BILLETS—
American Steel & Wire Co., Chicago, Ill.
Cabeen Co., Philadelphia, Pa.
Champion Iron & Steel Co., Muskegon, Mich.
National Steel Co., Chicago, Ill.
Bethlehem Steel Co., South Bethlehem, Pa.
The Lorain Steel Co., Lorain, O.
Jones & Laughlins, Ltd., Pittsburg, Pa.
American Steel Hoop Co., Pittsburg, Pa.
C. R. Baird & Co., Philadelphia, Pa.
Aliquippa Steel Co., Pittsburg, Pa.
Jerome Keeley & Co., Philadelphia, Pa.

STEEL CARS—
The Pressed Steel Car Co., Pittsburg, Pa.

STEEL CASTINGS—
Otis Steel Co., Cleveland, O.
Q & C Co., Chicago, Ill.
Bethlehem Steel Co., South Bethlehem, Pa.
Acme Steel & Malleable Iron Works, Buffalo N. Y.

STEEL CEILINGS—
Berger Manufacturing Co., Canton O.

STEEL FRAME MILL BUILDINGS—
Wm. B. Scaife & Sons, Pittsburg, Pa.

STEEL HOOPS—
American Steel Hoop Co., Pittsburg, Pa.
STEEL PLANTS—
The Wm. B. Pollock Co., Youngstown, O.
The Riter-Conley Co., Pittsburg, Pa.
STEEL SHEETS—
E. H. Stroud & Co., Chicago, Ill.
Republic Iron & Steel Co., Chicago, Ill.
American Sheet Steel Co., New York City.
McCullough Iron Co., Wilmington, Del.
STEEL TUBING—
Atlantic Tube Co., Buffalo, N. Y.
STRUCTURAL IRON WORK—
W. W. Lindsay & Co., Philadelphia, Pa.
TANKS—
Enterprise Boiler Co., Youngstown, O.
Meehan Boiler & Construction Co., Lowellville, O
Wm. B. Scaife & Sons, Pittsburg, Pa.
The Wm. B. Pollock Co., Youngstown, O.
Riter-Conley Mfg. Co., Pittsburg, Pa.
The Aultman Co., Canton, O.
The United Boiler Co., Girard, O.
TANK CARS—
The Wm. B. Pollock Co., Youngstown, O.
TESTING MACHINERY—
Keystone Driller Co., Beaver Falls, Pa.
TIN AND TERNE PLATES—
E. H. Stroud & Co., Chicago, Ill.
American Tin Plate Company, New York City,
Champion Iron & Steel Co., Muskegon, Mich.
TIN PLATE MACHINERY—
Totten & Hogg Iron and Steel Foundry Co., Pittsburg, Pa.
West Penn Foundry & Machine Co., Avonmore, Pa
TOOL STEEL—
C. H. Besly & Co., Chicago, Ill.
Bræburn Steel Co., Bræburn, Pa.
Crescent Steel Co., Pittsburg, Pa.
La Belle Steel Co., Pittsburg, Pa.
Monongahela Iron & Steel Co., Pittsburg, Pa.
TRAMWAYS—
A. Leschen & Sons Rope Co., St. Louis, Mo.
TRANSMISSION MACHINERY—
Heyl & Patterson, Pittsburg, Pa.
Link-Belt Machinery Co., Chicago, Ill.
W. A. Jones Foundry & Machine Co., Chicago.
Jeffrey Mfg. Co., Columbus, O.
Dodge Mfg. Co., Mishawaka, Ind.
The Aultman Co., Canton, O.
Brown Hoisting and Conveying Machine Co., Cleveland, Ohio.
TROLLEY TRACKS—
Northern Engineering Works, Detroit, Mich.
TRUCKS—
Northern Engineering Works, Detroit, Mich.
TUBES—
National Tube Co., Pittsburg, Pa.
S. Fix' Sons, Cleveland, O.
Atlantic Tube Co., Pittsburg, Pa.
TUBE WELDING—
S. Fix Sons, Cleveland, O.
TUMBLERS—
Northern Engineering Works, Detroit, Mich.
TURBINE WATER WHEELS—
Stilwell-Bierce & Smith Vaile Co., Dayton, O.
TURNBUCKLES—
Republic Iron & Steel Co., Chicago, Ill.
Cleveland City Forge & Iron Co., Cleveland, O.
TWIST DRILLS—
C. H. Besly & Co., Chicago. Ill.
TWIST DRILL CASES—
Vulcan Mfg. Co., Pittsburg, Pa.
VALVES—
James B. Clow & Sons, Chicago, Ill.
C. H. Besly & Co., Chicago, Ill.
Jenkins Bros., New York City.
James Bonar & Co., Pittsburg, Pa.
WASHERS—
Avery Stamping Co., Cleveland, O.
Milton Manufacturing Co., Milton, Pa.
WATER PIPE—
Massillon Iron & Steel Co., Chicago, Ill.
WATER SOFTENING PLANTS—
Wefugo Co., Cincinnati, O.
The Ideal Manufacturing Co., Buffalo, N. Y.
WELDLESS TUBES—
Atlantic Tube Co., Pittsburg, Pa.
WIRE—
American Steel & Wire Co., Chicago, Ill.
WIRE COATING—
The Ironsides Company, Columbus, O.
WIRE FENCING—
American Steel & Wire Co., Chicago, Ill.
WIRE FILLER—
The Ironsides Company, Columbus, O.
WIRE MACHINERY—
S. W. Goodyear, Waterbury, Conn.
Mossberg & Granville Mfg. Co., Providence, R.I.
Turner, Vaughn & Taylor Co., Cuyahoga Falls, O
WIRE NAILS—
American Steel & Wire Co., Chicago, Ill.
Kelly Nail & Iron Co., Ironton, O.
WIRE ROPE—
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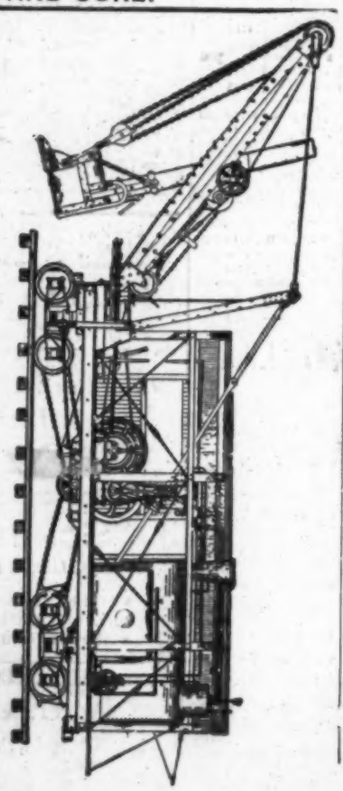

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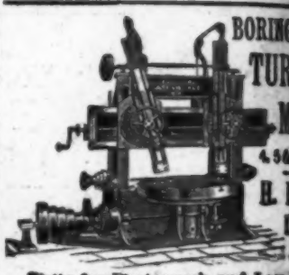

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